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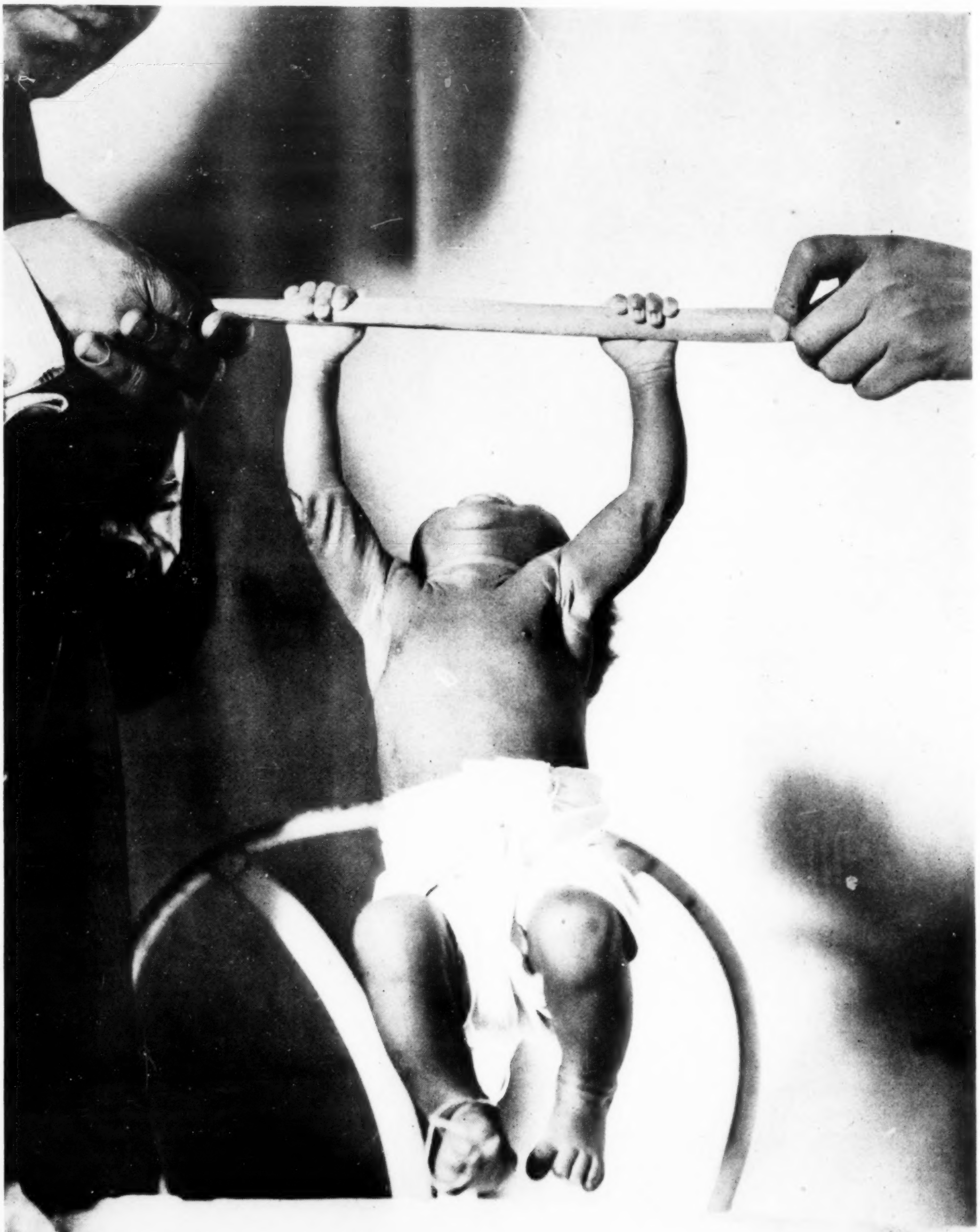


MONTH OLD BABE SUPPORTING ENTIRE WEIGHT BY GRIP ALONE

Although his muscles were so undeveloped that he was unable to hold his head up, this thirty-days-old babe was able to hang by his hands for more than one minute, and repeated the performance as often as the stick was put in his hands. This ability seems to be present at birth, but to decrease after the age of one month is reached. The thighs are bent at right angles to the body and the soles of the feet are approximated so that the entire attitude is more simian than human. This ability probably points to the old time arboreal life when the infant was forced to cling to its mother so that the latter might have her hands free. Photograph of a color d babe by John Howard Paine, through the courtesy of Dr. Price Hearst and Dr. Simeon Carson of Freedmans' Hospital. (Frontispiece.)

ARBOREAL MAN

Ancestors of the Human Stock Must Have Taken to the Trees at a Very Early Period—Tree-dwelling Habit Largely Responsible for the Success of the Stock in Evolution—Man in Many Respects Is Still Amazingly Primitive

IT IS sometimes supposed that man's ancestors acquired most of their "human" characters at the time they began to walk upright. But this supposition is not well founded. The traits of the human race seem largely to have arisen in the long period during which the ancestral stock lived in trees; and Dr. F. Wood Jones has written an extremely interesting book to point out some of the principal results of that arboreal existence.[1]

The evolution of the fore-limbs is one of the most striking features of man's progress. The legs of vertebrates are probably developed from the fins of fishes; and the earliest vertebrates, like the water newt and salamander today, doubtless had legs which served to balance the body but were hardly able to support it. A critical step was taken when, as in the Therapsids and Theromorphs, legs developed enough to walk on. To the primitive mobility was added an essential stability. But gradually the former had to be sacrificed to the latter, and in most quadrupeds the mobility of the fore-limbs long since disappeared. In man, however, it remains. The fore-limbs are not adapted to walking on, as anyone can testify who has tried to walk a hundred yards on all fours. The question is: Did man's ancestors ever walk on four legs, as most animals do? It is impossible, says Dr. Wood Jones, to believe that they did. The arboreal habit saved them from becoming quadrupeds, and thereby enabled them to acquire supremacy over all other forms of life.

"The arboreal habit alone is not the talisman; other mammalian stocks have taken to an arboreal habit; but they have taken to it after varying periods of quadrupedal life. They have taken to it too late to derive the full benefits from it, for they took to it with the fore-limbs already deprived of some of their inherited mobility. Such animals never become perfect tree-climbers. They may acquire an extraordinary skill in running about the branches of trees, as many rodents do, or they may even climb in the proper sense of the word, but in this climbing the grip is not obtained by the application of the palmar surface of the hand, but by the hook-like action of claws and nails; this method is practiced by many of the carnivora. The maximum of possibilities is not attainable in any of these cases." The power of *grasp* is all-important.

VALUE OF A HAND-GRASP

"The power to grasp with the hand and fingers seems such a very simple accomplishment that it is difficult to realize how such an apparently trivial beginning can have produced the tremendous changes that follow in its train. The power of the hand-grasp has made possible the forerunners of the Primates, has perfected the evolution of the Primates, and paved the way for the development of Man."

After an elaborate discussion of the anatomy of the forearm and hand in man and various other animals, Dr. Wood Jones says, "It would be a difficult matter to find the author who, writing of the human forearm and the human hand, has not seen in them the very highest and most perfect development of the animal kingdom. It has long been customary to lavish praise

[1] *Arboreal Man*, by F. Wood Jones, M.B., D.Sc., professor of anatomy in the University of London. Pp. 230, with many illustrations. London: Edward Arnold, 1916; New York: Longmans, Green & Co., Fourth Avenue and Thirtieth Street. Price $2.40 net.

upon this culmination of human perfections, or climax of evolutionary advances, as writers of different periods have judged it. Those modern authors who have seen so much in the so-called 'attainment of the erect position' (Munro) have been especially lavish in their praise of the human hand as a mere anatomical structure. Dr. Munro, in his presidential address at the British Association in 1893, permitted himself the expression that the human hand is 'the most complete and perfect mechanical organ Nature has yet produced.' Such a statement on the part of an anatomist can only be attributed to enthusiasm, and to a failure to differentiate between the very primitive anatomical condition of the hand and the perfection of this simple mechanism when linked to a human brain."

"After 1859 [publication of the *Origin of Species*] the forearm and hand, in common with every other feature of the human body, came to be regarded, not as a wonderful and specially designed structure, but as the perfected products of accumulated ages of evolution—the last thing in animal development and specialization. It is no overstatement of the case to say that Man was regarded by many as the last thing made, the culmination of evolution, and for some opponents of the new teaching and for some of its supporters he was the most modern animal. The orthodox chronology was accepted, the 'highest' form was the last form made, but instead of being the latest creation, he was the latest evolution. Huxley soon exposed the folly of this notion when it was definitely brought forward by an opponent. But though the statement of the idea as expressed by Mr. Gladstone may have been very crude, and its demolition easy by such powers of argument as were Huxley's, still, in more subtle guise the same idea becomes presented under many forms even today, and this not by any means necessarily from opponents of evolution, in such forms its refutation is not always easy. In even the most rigid and strictly scientific investigations in comparative anatomy this tendency is at times manifested. The human type of joint, or nerve, or muscle, or what not is so often assumed to be the last perfected—the culminating type. There is a vague idea, which insinuates itself in many ways, that the human type of structure must be derived from, and have passed through, stages seen in a series of 'lower' animals. A foolish argument may be permitted in dealing with a folly. Were a horse capable of writing works on comparative anatomy, he would probably, and with far more justice, regard his race as being the last effort in evolutionary chronology, and he would, and again with far more justice, derive his highly specialized limbs from those of some such primitive form as Man."

FOREARM IS PRIMITIVE

In these hypothetical horse compositions "there is no doubt that the human forelimb would suffer badly. Far from being regarded as the acme of evolutionary processes, it would be judged as an extraordinary survival of a very primitive feature far into the mammalian series, and more would be written upon its striking similarity to the corresponding member in the salamander and the tortoise than of its adaptation to the multitude of human functions."

"We have hurriedly reviewed the process by which a mammal with four undifferentiated and mobile limbs achieved the emancipation of its forelimb by its climbing activities. It is now necessary to make an attempt to follow the changes which take place in the hindlimb under the same circumstances." The most primitive hindlimb that can be imagined is in every way the counterpart of the forelimb; it changes because of the fact that most of the weight of the body is thrown upon it in climbing.

"The arboreal habit conferred its benefits by emancipating the forelimb from the duties of support and progression, and, by differentiating its functions from that of the hindlimb, it saved the animal from becoming quadrupedal. In differentiating the functions of the two sets of limbs, the animal gains a great deal. Some ani-

A VERY PRIMITIVE TYPE OF LEG

The salamander, shown above, has an exceedingly primitive leg, which is of value to him in paddling but hardly adequate to support the weight of the body. It is supposed that the mammals descended from a form something like this, with legs that were of very little value. Some of the mammals, such as the horse, developed highly specialized legs; but the human stock retained its members in a relatively primitive condition, a fact which has been of tremendous value in the evolution of man. Photograph from above natural size by John Howard Paine. (Fig. 1.)

mals, one might almost say, have gone too far in adapting themselves to the arboreal habit. An animal, saved by the arboreal habit from becoming quadrupedal, does not gain the maximum of the benefits derivable from its new mode of life, if it is saved from this fate only to become quadrumanous. Four feet do not lead far in the struggle for mammalian supremacy, four hands do not lead a great deal farther. It was the differentiation into two hands and two feet that provided the great strength of the stock from which man arose."

"The human hand, a strangely, almost shockingly, primitive survival, has received enormous praise mistakenly lavished by the philosopher and the anatomist; but the human foot, a wonderfully modified and distinctly human member, has had but scant appreciation. . . . The foot is apt to be regarded as a poor relation of the hand, as a thing which, once being far more useful, has degenerated, within the narrow confines of a boot, into a rather distorted and somewhat useless member. Although in modern Man the

boot has had its definite influence (as in limiting the possibilities of the power of grasp), such generalizations concerning the human foot are very far from true. If Man should wish to point with pride to any organ, the structure of which definitely severs him from all other existing Primates, it is to the foot he should point. If 'missing links' are to be tracked with complete success, the foot, far more than the skull, or the teeth, or the shins, will mark them as Monkey or Man. The weakness of Achilles lay in his heel; the weakness of the arboreal Primate masquerading as man lies in the structure of its foot."

To one who is not an anatomist, the most striking difference is in the relative lengths of the toes. In the Gorilla the middle digit on both hand and foot is the longest. The "digital formula" for the foot is exactly the same as for the hand; both may be expressed as: 3>4>2>5>1. Such a formula is an exceedingly primitive one, and is found as low in the scale as in water tortoises, at the present day. "The strangely primitive human hand has an identical digital formula, the third being the finger that reaches farthest forwards, the fourth the next, the second the next, followed by the fifth, and the thumb is farthest back of all. There is an almost equally common variation in the human hand in which the second digit may be as long as, or longer than, the fourth, and this is doubtless due to the functional importance of the index finger. I am not sure that it should not be considered as the typical human condition. In such cases the formula stands thus: 3>2>4>5>1, or 3>2=4>5>1.

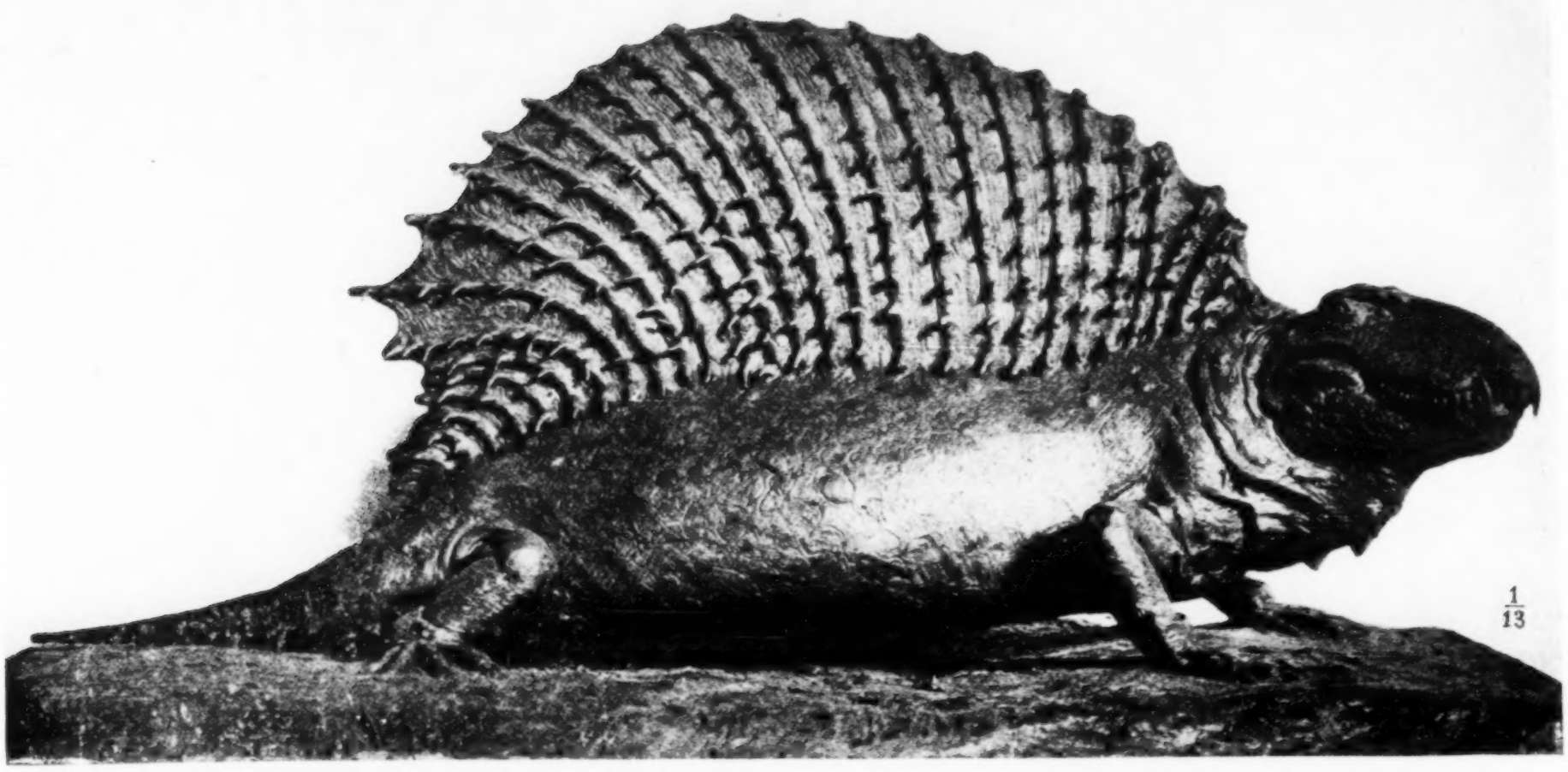
"Man retains a very primitive digital formula for his hand. His nearest Primate kinsfolk retain it for both hands and feet.

ALTERATIONS IN THE FOOT

"It is when we attempt to apply this formula to the human foot that we see how great is the alteration that has taken place between the existing anthropoid with the best primate foot and Man himself. The digital formula for the human foot is as a rule: 1>2>3>4>5. Such a statement holds good for a majority of the present-day British people. It is commonly assumed by artists, and even by surgeons, that the elongated big toe which projects in advance of the other four toes is not a natural human characteristic, but is a result of boot pressure. A long big toe is regarded rather as a deformity than as a natural human possession in which to take justifiable pride.

"Professor Flower long ago turned his attention to this point, and he examined the feet of hundreds of the barefooted children of Perthshire, and among them all he found no case in which the big toe did not project beyond the second toe. We must look upon a big toe which dominates the whole series as a typically human and a perfectly natural feature. Nevertheless, it is common enough to see feet in which the second toe is longer than the big toe. People who have feet with such a digital formula are apt to be somewhat proud of the fact, for such a foot is supposed to conform to the 'Greek ideal,' but that this type of foot was ever the ideal of the Greek artists is disputed by some authorities on the subject, and certainly we may assume that it is less typically human, and more ape-like, than the type of foot of the average hospital patient who possesses a long big toe."

"Zoologically speaking, we may say that the very useful and specialized foot adapted for terrestrial progression is a foot of few digits. It may, in fact, be a foot composed of a solitary digit. The evolutionary stages by which the horse has come to stand solely upon its third digit are well known. Similar processes produced the two digited foot of the deer and of the ostrich. There can be no doubt that Man is trusting, not to his third digit, but to his first, and that all the others are undergoing a process of comparative atrophy. This is in reality a most interesting problem. There is an admitted tendency to specialize one digit in a thoroughly adapted terrestrial foot. Man applied an arboreal foot to terrestrial progression, and in this arboreal foot the



THE THEROMORPH HAS A LITTLE SPECIALIZED LEG

This animal, one of the extinct reptiles, represents a stage slightly above that of the newt-type, the legs now being strong enough to support the body on land, but still not specialized for rapid movement. The Theromorphs, of which the above is a model of a Naosaurus from the Permian strata in Texas, by Charles R. Knight, are supposed by many to represent the type of reptile from which the mammals (man among them) took their rise. The human stock took to the trees at an early date and thereby avoided having to develop legs for running on the ground. Other animals which developed such legs did not succeed in developing their brains to the extent that the tree-dwellers did. After Henry Fairfield Osborn, in *Fossil Vertebrates in the American Museum of Natural History*, Volume iii, Plate IX, 1904-1908, page 265. Restoration by Charles R. Knight. (Fig. 2.)

best developed member was the old grasping digit—the first or big toe. It seems that upon taking to a terrestrial life he has started the elaboration of this already specialized toe, and is tending toward the development of a foot which is quite unique—a foot in which the first digit is the dominant, and in the end, perhaps, the sole surviving, member.

DEGENERATION OF THE LITTLE TOE

"It needs no special demonstration to make plain the fact that the little toe is somewhat of a rudiment in most Europeans. Usually it is but a poor thing; its nail is ill developed, and at times no nail is present. It is particularly liable to that circulatory disturbance which manifests itself in chilblains, and not uncommonly it seems in a poor state of nutrition. Most people possess but little power of movement in it, and its skeleton shows that its atrophic condition has affected the bones and the joints, for the last two phalanges are very commonly fused together, making it short of a joint as compared with the other toes. Very commonly its axis is not straight, and the toe is humped up and also somewhat bent laterally.

"It is easy to assume that all this is merely the result of wearing boots, but it is perfectly certain that this common explanation is not the correct one.

"In many races, the members of which are quite innocent of wearing boots at any time of their lives, the little toe is just as atrophied as it is in the average London hospital patient, and in some unbooted native races it is even more degenerated that is common in the booted Londoner. Among the Malays, the absence of a nail upon the remarkably stumped fifth toe is not at all uncommon. The barefooted races in Nubia are no better off in this matter, and even in the very primitive Sakai the

little toe has suffered." Similar conditions are noted in various other savage races, and are found in Egyptian mummies (see Fig. 5).

As a rule, the terminal joints of the toes are the first to degenerate. "One very curious evidence of this skeletal condition is seen in very many feet, even when the big toe is far in advance of all the rest. Although a line joining the tops of the toes slopes without interruption from the first to the fifth, a line joining the bases of these toes does not follow the same course. From the first cleft it rises to the second, and from the fourth cleft it rises to the third, and there is thus produced a sharp angle in the line which usually falls opposite the middle of the base of the third digit. This line has exactly the same contour as in the hand, and is the typical one seen in the monkey's foot." It is the outer toes which are undergoing atrophy, and the atrophy begins at their outer ends, hence it has not yet affected the primitive outline of the foot.

CHANGES IN THE FACE

Accompanying the liberation of the forelimb and the use of the hand for feeding, there went a recession of the snout which has produced some well known changes, particularly in the teeth. The preparation of food by the hand is carried farther and farther; the teeth no longer have bones to gnaw or nuts to crack "and it is not to be denied that, slowly, of course, but still surely, they are undergoing atrophy. Among existing races of mankind the fact is patent, the observation is a commonplace of anthropology. The possession of an ample palate and large, well-formed teeth by the black races is a matter of common knowledge (as is the fact that in the crania of the prehistoric inhabitants of Europe the size and quality of the teeth were superior to those at present obtaining in the same geographical area). It is therefore impossible to overlook the inference that reduction in the size of the teeth is at least attendant (if not dependent) upon the acquisition of higher grades of civilization and directly upon diet and the preparation of food.

"This, from the writings of Dr. Duckworth, may be taken as an orthodox statement of the general position as summed up in modern anthropology. The more primitive races have larger and better formed teeth, rooted in more roomy palates, than members of more civilized races can boast of."

The third molars, wisdom teeth, being the last to be erupted in the already diminished jaws, show the maximum effect. In modern civilized Man these teeth are erupted late, sometimes not at all, or in only one jaw. They are always small, and frequently do not meet and bite together. They are liable to early decay. "In primitive races they are rarely absent, they are cut earlier, and are but little if any smaller than the other molars, and they bite and grind together in a perfectly even manner."

The recession of the snout has already been mentioned; the recession of the chin is equally to be observed. "The dawn of a chinless aristocracy is no pleasing picture in the later stages of human evolution; and yet the recession of the modern jaw is not to be denied." One of the effects is to overcrowd the teeth, so that while man has fewer teeth than his relatives, they are closer together. "Man is the only living primate that has its teeth arranged in a continuous series, and it is one of his distinctions that there are no gaps between them. The process of the shortening of the snout, outstripping the process of reduction of the dental series, gives rise to one of the great problems of modern dentistry—the proper treatment of the many evils arising from overcrowded jaws."

ABDOMINAL EFFECTS

In the vague general idea that man, from walking on all fours, suddenly began to walk upright, this supposed change is thought to have had many evil consequences by forcing a readjustment of all man's viscera. The tendency to rupture is one of numerous such supposed consequences. But Professor Wood Jones points out that this

THE FOUR HANDS OF AN ANTHROPOID

The hands of the great apes are not much inferior to those of man, and their feet are almost as good as their hands for grasping. Now it is supposed that the development of the power of grasp is one of the things that gave the human stock its supremacy in the evolutionary competition. Since the anthropoids are better endowed for grasping the limbs of trees than is man, why should they not have gone ahead? Photograph by E. R. Sanborn, New York Zoological Society. (Fig. 3.)

picture has been greatly overdrawn; for if man's ancestors were arboreal, and perhaps never ran about on four legs on the ground, it must be noted that an animal sitting in a tree is almost as upright as is one standing on two legs on the ground.

"The upright poise of Man has been lauded as one of his greatest distinctions. This praise of human uprightness has, without doubt, been carried to absurd extremes, so also has the tendency to ascribe to this same uprightness a multitude of human weaknesses and disabilities. This visceral uprightness is no new thing; the readjustment has been gradual, and some measure of it has been very long established. It is easy to overdo the praise of the poise. It is equally easy to overdo the condemnation of it as a cause of many human ills."

One of the consequences of arboreal life which has not often been emphasized is the reduction in number of offspring. Large litters can only be produced where the female is living in a sheltered situation during pregnancy; they can only be cared for in a position that is much safer than a tree-top. But Professor Wood Jones ascribes to the arboreal habit a change of still greater importance—that which has produced the human brain.

In the forerunners of the mammals the sense of smell was the principal "mental" possession, and this continues to be true even in many low

ma nmals, among whom "friends, and food, are found by their scent; foe are avoided by the same sense, and the whole sexual life of the animal is lived in a like atmoshpere." But when Man's ancestor's took to the trees, the sense of smell became of less importance, for no trail of scent is left among the trees as it is on the ground. The uselessness of the sense of smell opened the way for the development of the other senses, and of other parts of the brain, to the great degree in which Man now shows them. Nevertheless, this primeval sense which in modern man is none too well developed and is a very minor factor in his life, "still shows a subtle power as a memory sense. Dudley Kidd has noted this feature in investigating the psychology of Kafir children. 'When Kafirs are questioned as to their earliest remembered impressions they usually state that these were connected with the senses of taste and smell. The next things they remember are connected with the sense of color; then impressions of sound and of form seem to follow last of all.' In still more primitive races the importance of smell impressions is probably greater; and there are few of us who have not some complex memory picture associated with an early impression of smell."

THE SENSE OF TOUCH

The sense of touch was likewise modified by arboreal life, coming to be centered largely in the hand. This helped emancipate the animal from its domination by the sense of smell, and it contributed to the development of new areas in the brain.

The evolution is evidently harmonious in its details. The more the forelimb becomes emancipated, the less is the hand called upon for menial duties which in other stocks necessitate the development of skin-thickenings, pads, callosities, or hoofs. It is the freed hand which is permitted to become the sensitive hand, and it is the freed and sensitive hand which now, so to speak, goes in advance of the animal and feels its way as it climbs through life. The animal no longer smells out an object subsequently to feel it with its nose; but it feels with its hand some object that comes within its reach in the customary round of arboreal activities, and it may or may not subsequently add to its knowledge of the object by smelling of it. Tactile impressions gained through the hand are, therefore, constantly streaming into the brain of an arboreal animal, and new avenues of learning about its surroundings are being opened up as additions to the old olfactory and snout-tactile routes. With the development of the power of grasp, new and great possibilities come in. Much may be learned of an object that can be felt by the hand; much more of an object that can be grasped, lifted and examined in the hands. When an object can be grasped and lifted it can be examined from every point of view, and the eyes must play a large part in this examination. Its whole outline, the texture of its surface, its hardness or softness, its size, temperature, and weight, can all be ascertained. It is difficult for us, with our perfected cerebration, to appreciate the difference which the power to grasp an object makes to an animal attempting to learn the nature of objects with which it comes in contact, but we may be sure that the difference was very great, and was made greater when the power to pick up the object and to examine it from all points of view was added.

HIGHER MENTAL FUNCTIONS

It is even possible, Professor Wood Jones thinks, to connect the evolution of higher mental functions with the arboreal life of man's ancestors; to find a partial clue to the origin of those "higher ideals of conduct" which some critics have alleged could not possibly be explained on an evolutionary basis.

It has already been pointed out that arboreal life leads to a reduction of the number of young produced at a birth. This is, of course, a mere adaptation to life circumstances, and is not confined to the Primates but will occur wherever there is no natural nursery for the young. If the tree-dwelling ape has but a single young at a birth (as a rule), so do the horse and the whale.

DID THE ANTHROPOIDS FOUND THE PERMANENT FAMILY?

Lower mammals whose progeny are able to fend for themselves within a comparatively short time after birth are rarely paired for long. The offspring, being able to take care of themselves, break away from their parents, and as there is no further dependence on the male for defending the offspring and mother, the parents soon separate, and form other combinations the next year. But in the Primates, as the period of dependence of the young becomes lengthened, the dissolution of the family ties is delayed more and more until it eventually is delayed until the recurrence of the next mating season. Thus the union tends to become permanent. Photograph by E. R. Sanborn, New York Zoological Society. (Fig. 4.)

Large families can only be indulged in by animals that can have a safe retreat in which to rear their numerous young, or by animals sufficiently equipped with weapons to guard them.

"Of those animals which, having no nursery to hand, have a reduced litter, there are two distinct classes. The first class, for which we may turn to the horse (as a representative of the Ungulates) for an example, is made up of animals whose roaming life is composed of a series of escapes from danger: animals that depend for their safety not upon their retreat into burrows, holes, or any other fastness open to some smaller beasts, but upon the swiftness of their open escape. These cannot be successful if the females are handicapped by the disabilities of pregnancy with large litters, or by the nursing of helpless offspring. In them the number of offspring is reduced, and the usually solitary infant is born singularly mature, so that it may share as soon as possible in the life-saving activities of its species.

"The solitary young of such animals is born grown up, it can flee at its mother's side within a few hours of its birth. Its period of dependence upon its mother is relatively short, and there is but little infancy, or childhood for such a baby. In the second class come the arboreal animals. There is no natural nursery among the tree-tops, and the disabilities of pregnancy with a large litter are felt as keenly in active tree-climbers as in any class of animals. No doubt nest-building was resorted to as a temporary expedient in the arboreal stock; and among all the arboreal and semi-arboreal animals, derived from many orders, nest-build-

ing, in some members, is still the rule. But nest-building only overcame a temporary disability, and in the end, reduction of the family solved the problem.

THE PRIMATE BABY

"The baby of the perfectly adapted arboreal animals of the primate stock is solitary; but it is a baby very different from that we have pictured in the previous group. The arboreal baby is born immature, and it is singularly dependent upon its mother in the precarious circumstances of life among the branches. There would seem to be no alternative in such a life; the baby must either be born a perfected tree-climber, or it must be a more or less immature creature dependent upon others for its safe conduct among the branches. As a matter of fact, the offspring of the Lemurs and Monkeys are born immature and comparatively helpless, save for the power of grasp which is well developed in their hands. Naturally they cannot immediately follow their mother upon her arboreal excursions; and among the Lemurs it is the rule for the young to grasp the mother, and among the Monkeys for the mother to assist by grasping the baby with her wherever she goes; this, at the outset, is a new factor in the relation of mother and offspring. We may surmise that in this new relation there is given a wider scope for the working of that very primitive display of instinct summed up in the commonly used phrase 'maternal care.' Maternal care is, of course, perfectly well manifested in animals situated very differently from those we are studying; it is, in some of its manifestations, a widespread and primitive animal instinct. But the phrase 'maternal care' when applied to a mother that, in time of danger, defends a dozen helpless offspring connotes something rather different from its extension to a mother that carries a solitary offspring which clings to her throughout a somewhat prolonged infancy.

"It is to be regretted that observations upon the intimate details of the lives of the Primates in their natural state are not made more frequently by those having the opportunity to do so. Among the Lemurs, Charles Hose has noted how *Tarsius* carries its baby in the way common among cats, by picking it up with the teeth. It evidently does not nurse its offspring. The young *Nycticebus tardigradus* clings tight to the mother, and the mother makes but little effort to handle the young. It will bite savagely if an attempt is made to remove the baby from its fur, but, as a rule, it resents any other interference in exactly the same manner. On one occasion a female *Nycticebus* escaped from its cage at night, and left its baby, which was still suckling, to its fate. The baby, which was reared on the bottle, used its voice freely each evening, but the mother, though living in some trees quite close to its cage, never returned to it. The voice of the mother was heard on rare occasions, but five years passed before her actual home was discovered; even then she was still within a few paces of the spot in which she started her freedom, and in the meanwhile the young one had died.

MONKEY MOTHERS

"I do not know of any recorded observations which show that in the Lemurs the maternal instinct is very much developed beyond its display in carrying the helpless baby clinging to the mother's fur. With Monkeys, however, the care for the young is very real, and several observations have been recorded upon this point. Both in their natural state and in captivity, Monkeys show the greatest concern in the well-being of their offspring. That they will defend them from attack is nothing, for such a display of maternal instinct is the common property of most living creatures, but the Monkeys go further than this in the development of those numerous tendernesses for their young which in all accounts are, and can only be, likened to human parallels.

"With the Anthropoids, so far as opportunities for study in their natural state have been permitted, there is every evidence that maternal and pa-

ternal care is carried still further. Many observers have noted the human manner in which the Gibbons attend to their young, and the mothers have been seen to take their babies to the water and carefully wash and dry them (Bock); even the Gorilla has been seen to correct its offspring by boxing its ears when it misbehaved (Koppenfels). Not only is the display of maternal care much more marked in all these higher arboreal Primates, but it is exercised for a much longer period than in any other animals. Arboreal Primate babies have a very long babyhood and a long infancy. The baby Gibbon (*Hylobates lar*) clings to its mother for about seven months (Blanford), and it is not fully mature until it is fourteen or fifteen years old (Hartman). The young Orang-utan is dependent upon its mother for about two years, and is not fully adult until it is fifteen (Forbes).

"This prolongation of infancy, and the period of youthful dependence, has probably a rather widely reaching influence. It calls for a much more prolonged exercise of parental care and control, and causes these attributes to be more or less permanent characteristics, rather than periodically recurring manifestations of an instinct. Again, the prolongation of infancy may be said to be the especial factor which created the family as a social unit. In almost all the higher vertebrates it is the habit of the male parent to remain with the mother during the helpless early stages of the offspring, and in many instances (in several orders) he even plays his part in caring for the young during their most dependent period. In the Primates, the share that the male takes in the duties of parenthood has often been noted. The males have repeatedly been seen to carry the young on their arboreal journeys, and it has even been asserted that the male of the Siamang Gibbon (*Hylobates syndactylus*) always carries the baby if it be a male, the female parent carrying only the female offspring (Diard).

AN EGYPTIAN TOE

The atrophy of the little toe in many modern feet is sometimes supposed to be due to wearing boots. But it seems to be a general evolutionary trend, which is tending to reduce the human foot to a single toe (the first or big toe). This foot of an Egyptian mummy of the XX dynasty, about 1300 B. C., shows that the little toe was in a deplorable state even then, centuries before boots appeared in Egypt. The last phalanx is diminutive and its joint is ankylosed. Photograph from Dr. Gorgy Sobhy, School of Anatomy, Cairo. (Fig. 5.)

FOUNDATION OF THE FAMILY

"In whatever degree parental duties to the helpless offspring are discharged by the male arboreal Primate, it is evident he is only fulfilling a general biological law; but it also follows that if infantile helplessness is prolonged, his parental duties are liable to a similar extension. Here is evidently the beginning of that association of mother, father and child which, lasting beyond a brief period comprised in courtship, the suckling of helpless young, and the guarding of mother and off-

spring, lays the foundation of the family.

"When infancy is brief, the family bond is similarly of short duration; and, the period of suckling being ended, there comes a time of expansion of infantile enterprises, a time marked by some internecine strife and much parental intolerance. It becomes a necessity for the mother to repel the young when mammary activity is ended; it devolves upon the father to chastise any possible rivals: and in most large littered animals the family tie loosens and dissolves as soon as the young are fully capable of fending for themselves. As the period of dependence of the solitary offspring becomes more protracted, the advent of the dissolution of the family is naturally delayed —it may be delayed until the recurrence of the next natural parental sexual season. This I imagine to be a very important factor. If the bond of the helpless offspring keeps the male in attendance until the next sexual period of the female, there is likely to be a recurrence of the whole process, and a step towards the permanence of their union."

THE HUMAN BABY

It is well known that details of the ancestral life of an animal can often be inferred from a study of it during infancy, and Dr. Wood Jones' chapter on "The Human Baby" is not the least interesting part of his book. Recalling that the arms of other Primates are longer than their legs, while the reverse is true in man, he points out that at one stage in the development of the human embryo the arms actually exceed the legs in length. Later the proportions are reversed. Even at birth, however, the baby's legs are relatively short compared to its trunk. The baby's feet resemble those of the anthropoids in being turned inwards, so that the soles can be pressed against each other—this indeed being a common position of rest in an infant as well as in an arboreal anthropoid. When children learn to walk, it is upon the outer sides of their feet that they trust their weight, exactly as the anthropoids are wont to do. It is this inherited arboreal foot-poise which leads children to wear out the outer edges of their shoes first. The remarkable grasping power of a new-born infant is likewise cited as the survival of a trait that possessed life and death importance in the tree-tops. Finally, with reference to the much-talked-about upright posture, the author remarks succinctly that "the human child sits up before it stands; the human stock sat up before it stood."

But, it may be objected, many other mammals have lived in the trees; why did they not progress as far as the human stock? From what has preceded, the answer is perhaps obvious. Either they took to the trees too late, after they were already specialized (as the squirrels, for instance), or once there they became specialized too far (as the bats, or the apes and monkeys which have four hands instead of two hands and two feet). It need not be pretended that this answer is all-sufficient, yet it undoubtedly contains a large part of the truth. Man's success in evolution must largely be ascribed to the fact that he has (except in brain) not evolved very far; he is in many respects still amazingly primitive.

Maine Station Collects Breeding Records

The Maine state experiment station has been for some time collecting information from cattle breeders of the state about their breeding operations. So far this cooperative project has made available data on cattle breeding from 192 different herds, including 3,085 cows and 217 bulls. Analysis of this material should produce some valuable results.

EUGENICS IN JEWISH LIFE[1]

Until Recently, Religious Customs Have Tended to Produce a Large Amount of Intellectual Ability, but Also a Large Amount of Defect—Changed Manner of Life Brings New Eugenic and Dysgenic Changes

MAURICE FISHBERG

Attending Physician, Montefiore Hospital, New York City

AMONG the many paradoxical peculiarities of the contemporary Jews there are some which are of immense interest to those engaged in the study of eugenics. The striking phenomenon of their survival as a religious and social group, despite their dispersal in all parts of the habitable globe, under all varieties of climatic conditions, is the more remarkable when it is borne in mind that after 1,800 years of severe and cruel persecution there are at present more Jews than there have ever been at one time. C. W. Saleeby, one of the best-known apostles of eugenics in England, is inclined to the opinion that it was the intense struggle for existence that made up their greatest source of unexampled strength; that the Jew who was a weakling or a fool had no chance at all. "The weaklings and the fools being weeded out, intensity and strength of mind became a common heritage of this amazing people," says Saleeby. To him the Jews, constituting "the one human race of which we know assuredly that it has persisted unimpaired, have been the most continuously and stringently selected of any race that can be named."

This theory of survival of the Jews, not in spite of persecution, but because of it, is not original with Saleeby. Many others have propounded it before, and some have even urged ruthless persecution of the unfit as the best means of improving certain elements of humanity, thus assisting "selection" through the survival of the fittest.

What are the facts about the number of able and talented Jews? It is well known that the proportion of persons of marked ability, of individuals who have gained distinction in any line of human endeavor, is much greater among the Jews than among the peoples of other faiths in whose midst they live. There is no need of burdening the reader with statistical figures substantiating this fact, which is well known to everyone who has given some thought to the subject. One has only to consider the enormous number of financiers, merchants, manufacturers, physicians, lawyers, musicians, artists, journalists, scientists, etc., of Jewish origin in Europe and America, and bear in mind that the children of Israel constitute but a small fraction of 1% of the white population of the world, to be convinced that the number of talented, able and successful persons among them is in excess of what would be expected if they did not excel in this direction.

But there are facts, indeed, uncontrovertible facts, showing quite the contrary.

It is a matter of common observation that the Jews are physically puny—a large proportion are feeble, undersized; their muscular system is of deficient development with narrow, flat chests, and of inferior capacity. They make the appearance of a weakly people, often actually decrepit, if only because of the proverbial bent spine, the "Ghetto bent." Moreover, physical defects, congenital and acquired, are notoriously common among them.

MANY DEFECTIVES

It is noteworthy in connection with the statement of Saleeby quoted above

[1] Extracts from an article published serially in five numbers (Jan. 26, Feb. 2, Feb. 9, Feb. 16 Feb. 23, 1917) of *The American Hebrew*, 44 East 23d Street, New York.

to the effect that fools have been weeded out from among the Jews, that the proportion of mental defectives, idiots, imbeciles, etc., is much higher among them than among others. It is of immense interest from the standpoint of eugenics that hereditary and degenerative defects are more frequent among them than among people of other faiths who live under a similar social and economic environment. Thus, blindness, color blindness, deaf-mutism, idiocy, imbecility, insanity, etc., have been found from two to five times more often among them than among the Christians in Europe. Eliminating most of the possible sources of error, as I have done in my book, *The Jews*, it must be acknowledged that the modern children of Israel, in spite of their phenomenal vigor in other respects, show a larger proportion of physical and mental defectives than any other civilized religious, social, or ethnic group of people.

We thus have, to a noteworthy degree, two diametrically opposed extremes among the modern Jews. On the one hand we have a very high proportion of feeble-minded, idiots, imbeciles and insane and also physical defectives, weakly and decrepit people; and on the other hand we saw that we have also an amazingly high proportion of persons of marked ability in nearly all walks of life, especially such as have attained eminence in the intellectual, commercial and industrial fields of human endeavor. These are facts which have great bearings on the subject we are about to discuss.

Sociologically, this contrast is even more strikingly evident among the modern sons of Jacob. There are found among them an excessive proportion of poor and destitute dependents, as well as a larger ratio of economically prosperous, and even millionaires, than their total number would lead us to expect. The popular envy of the "rich Jew" is based on the excessive proportion of successful Jewish bankers, merchants and tradesmen; while the frequently repeated pity expressed for the hordes of poverty-stricken and famishing Israelites in eastern Europe and the Orient, as well as the destitute aliens in London, Paris, Berlin and New York, finds its justification in the large number of Jews who are physically and mentally unfit for the intense struggle for existence demanded by modern life.

What are the causes of these peculiarities among the modern Jew? The sterotyped answer given by many writers that these, as well as most other characteristics of the Israelites, are the expression of the "racial peculiarities" does not hold in the light of recent research. Elsewhere I have shown that there is no such thing as a homogeneous and pure race, and that we can no more speak of racial unity among the Jews than we can speak of racial purity among those professing Christianity, Mohammedanism, or any other religion. Indeed, we find ethnically all kinds of racial elements among the contemporary followers of Judaism. Granting this, we must conclude that "race" cannot be considered the cause for these social, economic, and pathological differences between the Jews and the peoples among whom they live.

INFLUENCE OF RELIGION

We must bear in mind that up to about seventy-five years ago practically all the Jews in Europe and elsewhere were orthodox, and intensely religious. To the orthodox Jew the biblical ordinances, as well as the opinions of the rabbis, are binding in matters of matrimony just as in everything else. Jewish life in the medieval Ghetto was permeated by the spirit of the rabbis and shaped in accordance with their notions. Their marriage and divorce laws are remarkable and, on the whole, more in accordance with the principles of eugenics than the Christian and Mohammedan marriage laws. There are, however, some important exceptions which will receive attention later on.

Every Jew is in duty bound to marry and procreate as early in life as possible. According to the *Schulchan Aruch*, the recognized Jewish code, "it is the duty of every Jewish man to marry a wife in his eighteenth year, but he who anticipates and marries earlier is follow-

ing the more laudable course, but no one should marry before he is thirteen." According to the Talmud, a Jew who has not entered matrimony at twenty is damned, and the rabbis frequently compelled delinquents to marry.

The medieval Jews, and those in Poland as late as the middle of the nineteenth century, followed the Rabbinical ordinances implicitly. Most of the Jewesses were married before they reached the age of sixteen, and the husbands were not much older on the average. The oriental Jews are even at present apt to marry as early, and I saw in Algeria and Tunisia Jewish couples the combined age of whom was hardly over thirty. At present in Europe and in America such early marriages are exceedingly rare; indeed, it appears from statistical evidence gathered in various countries that the average age of Jews at marriage is even higher than that of the Christians among whom they live.

I do not know of any other social or religious aggregate that encouraged and practiced positive eugenic life to such an extent as the Jews did in the Ghetto. Most of the Rabbinical teachings are teeming with positive eugenic suggestions[2] and one is inclined to say that the rabbis anticipated Galton by about sixteen hundred years. They deprecated the marriage of a woman for her wealth, and urged that the daughter of the respectable family is most desirable for a good Jew; especially should the brothers of the bride be good and respectable men, for the character of the children is greatly dependent on the qualities of the mother, according to the rabbis.

The Talmud advises a good Jew to sell all he has in order to marry the daughter of a learned man. A marriage between the daughter of a priest, or of a learned man, and an ignoramus will not be successful, and all the promises of the prophets will be fulfilled upon him who gives his daughter in marriage to a learned man. The families most desirable for matrimonial alliances are classified by the rabbis in the following order: Those of the scholar; the most prominent man in the community (what Galton calls "civic worth"); the head of the community; the head of the congregation; the collector of charity; the teacher of children; while the children of an ignoramus are to be avoided, and one should not give his daughters to such persons.

PREMIUM ON INTELLECT

It is thus evident that the Rabbinical laws, which guided the orthodox Jew in his matrimonial affairs, place most reliance on the intellectual attainments of the contracting parties and their parents, thus increasing the chances of productivity of the best stock. In other words, *guided by these Rabbinical teachings, the medieval Jews' ideals of marriage centered themselves in the intellect of the prospective sons and daughters-in-law, and also that of their parents. They apparently were great believers in the potency of heredity and acted accordingly.* The rich sought young men with attainments in learning, and when they could not find suitable young scholars among those in their own social and economic status, they did not hesitate to take poor but learned young men for their daughters.

The rich and the learned thus formed castes among the Jews almost as stringent as those of India, abstaining from intermarriage with the poor to a certain extent, and especially and emphatically with the ignorant and lowly. The ideal of the rich Jew in the Ghetto has always been to give his daughter in marriage to a rabbi, and there were very few rich families which have not attained this ideal with at least one daughter. Even if the son-in-law was not expected to practice his profession and went into business after marriage, his diploma to the effect that he was sufficiently learned in the law to be qualified as a rabbi was sufficient to place him in the category of aristocrats.

Riches alone was not *Yichus*, or

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[2] An outline of the eugenic aspects of Jewish life prior to the dispersion was given in "Jewish Eugenics," JOURNAL OF HEREDITY, VIII, pp. 72–74, February, 1917.

aristocratic stock, in the Ghetto; the *lamdon*, the scholar, was the real aristocrat no matter what his parentage was. When a poor but capable and promising boy was discovered in the community there was sure to be found a rich man who would undertake his support till he reached maturity and married his benefactor's daughter. The scholar was even supported by his father-in-law for many years after marriage, often for life. In this manner the marriage and parenthood of the favored and best stock, *i. e.*, of persons of marked ability and civic worth, was greatly enhanced almost to a degree satisfactory to those who, with Galton, advocate radical methods of positive eugenics.

Jewish marriage laws, customs and habits have, however, not only been effective in encouraging the augmentation of the favored stock. We also find strong and active dysgenic tendencies which have been instrumental in encouraging the proliferation of an enormous number of physical and mental defectives among the children of the Ghetto. To begin with, even the rich usually cared but little for the physical appearance of the men they chose for their sons-in-law. All they cared for was the intellectual attainments of the young men; even deformities may not have militated against prospective bridegrooms, provided they were scholars of eminence or promise. They were, however, careful about the appearance of their prospective daughters-in-law, because the Talmud appreciated beauty in a woman, and every Jew was urged to marry a handsome wife; a dark-complexioned man should better marry a fair-complexioned woman, etc. This may, to some extent, explain why there are at present so many beautiful Jewesses among the inhabitants of the Ghetto, while beautiful men are rather scarce. Social selections may have had its effects.

DYSGENIC INFLUENCES

The most remarkable and far-reaching dysgenic factor operative among the Jews for centuries has been the institution known as *Achnoses Jaleh*—societies having the object to provide trousseaus and dowries for poor maidens in Israel. Unmarried persons of either sex were practically unknown in the Ghetto; every Jew had to marry and to procreate. In case of young men or women who were either too poor to venture into matrimony, or because of some infirmity, physical or mental, could not find consorts willing to cast their lots with them, these societies provided opportunities, and funds, to unite these defectives with life partners. Every physical and mental cripple was thus encouraged to marry and to bring legitimate offspring into the world. Occasionally it was necessary actually to force this sort of individual into matrimony and parenthood. A blind boy was united with a lame girl; deaf and dumb were coupled; the town fool was given a paralyzed wife; the insane was encouraged to marry an imbecile girl, etc. Public-spirited Jews, especially Jewesses, collected money to provide these unfortunates with trousseaus, cash dowries, furniture, etc. These defectives proliferated, no doubt, at a higher rate than healthy individuals, leaving a stock of degenerate offspring which were a burden on the Jewish community till they reached maturity, when they, in turn, offered opportunities to pious Jews and Jewesses to raise funds with which to marry them off.

I have already spoken of the professional marriage broker, the *Schadchen*, and his rôle in Jewish Ghetto life. Indeed, among the Jews, he was an institution; while peoples of other faiths have made use of marriage brokers, among the Jews he was more often called into service. In many cases these match makers worked along eugenic lines as, for instance, when the *Schadchen* was instrumental in bringing about the union of the daughter of a rich man with a budding scholar; or when he brought together well-known families from distant towns for the purpose of uniting their children in matrimony. But, on the whole, a great proportion of physical and mental defectives among the Jews of today owe their existence to his nefarious activities. Inasmuch as he was legally entitled to compensation

for his troubles, he usually stopped at nothing in his attempts at doing business. Jewish folk-lore and literature abound in tales of unscrupulous marriage brokers who brought about marriages between defectives and cripples. In Zangwill's *Children of the Ghetto* we find an excellent pen picture of the *Schadchen*, and many of the novels of Jewish life in Russian, German and Yiddish contain splendid types of this Jewish marriage broker. On the Yiddish stage he is very frequently portrayed in his true color. In eastern Europe he is as active at present as he ever was, and among the Jewish immigrants in London, New York, Philadelphia, Chicago, etc., he is still doing excellent business. Even among the rich, prosperous and ostensibly assimilated Jews in Berlin, Vienna and Paris, he is now quite often called into service by fathers of marriageable daughters, and by men who are willing to enter a matrimonial alliance with any woman who has money, or is likely to inherit it. This may be one of the important reasons why the proportion of defectives among the rich Jews of Germany is still higher than among the Christians in that country.

EFFECT OF CHARITY

Jewish charity, proverbially a model which others ought to follow, has no doubt been of great value to those who were in need of help from their fellowmen, expecially during the great calamities which often befell the Jews during medieval days, such as massacres, lootings of Jewish quarters, or expulsions which were so frequent during the Middle Ages and have not ceased during the twentieth century in Russia and Rumania. But during peaceful and especially prosperous times, this Jewish philanthropy has been an important dysgenic factor and is undoubtedly responsible in a large measure for much of the degeneracy observed among the Jews of today.

In medieval times, when charity and philanthropy were practically unknown among the Christians in Europe, excepting the little done by the Catholic Church, the Jews were just as active in the field of relief of the poor, the sick and the defectives as they are at present. In the treasury of information of Ghetto life, *Jewish Life in the Middle Ages*, by Israel Abrahams, we find enumerated the various agencies which were active in relieving poverty and pauperism. In the Ghetto of Rome there were so many philanthropic societies that their enumeration occupies several pages of Abrahams' book. They were all active in treating the sick, helping the defectives and incidentally encouraging the parenthood of those who, because of physical or mental infirmity, could not help themselves.

Modern organized charity has made an attempt to work along prophylactic lines, but, as far as I have observed, Jewish philanthropic agencies have not worked very assiduously along eugenic lines. In many Jewish communities in eastern Europe, and in some even in western Europe, there are found societies whose object is marrying every Jew and Jewess, irrespective of his or her physical or mental state. The itinerant Jewish beggar and mendicant, known as the *Schnorrer*, of whom Zangwill gave us such an excellent picture in one of his works, often begs for a dowry for his daughters. Things reached such a stage that many who had no marriageable daughters begged for alleged ones, and at present many carry with them certificates from the rabbi, or the head of the congregation of their community, to the effect that the bearer has one or more marriageable daughters who need dowry if they are to be saved from celibacy. As I stated already, in eastern Europe there are even at present societies for just this purpose.

As far as I know, we have no such societies in New York City, but I have known the case of a philanthropically inclined lady, in fact a director of a highly organized charity society, who spent several hundred dollars uniting two cripples into matrimony, and the newly wedded wife soon conceived and gave birth to a defective child, which she brought to the society asking for an increase in the allowance given her as a "pension." On the whole, the Jewish charitable agencies in Vienna, Berlin,

London, and especially New York at present, keep on supporting all the defectives, reckless and degenerate in their communities. In New York they are even "pensioned" so that they may at ease keep on proliferating at a rate which is appalling when it is considered that many of their children have physical or mental defects, and will, when reaching maturity, present grave social problems to the community.

I have already mentioned that the average age at marriage appears now to be higher among the Jews than among others. The reason is that they are mainly city dwellers, and their occupations require long years of preparation before fitting the person to earn a livelihood. The thoughtful, the intelligent and those endowed with foresight are not in haste to marry. They realize that marriage entails important obligations which a man of character must feel confident that he is fit to fulfil. It is different with the pauper who is by nature reckless, often actually parasitic. Matrimony to him is not an important event and entails no obligations and he plunges into it, knowing that his offspring will be cared for by charitably inclined persons or societies.

The Biblical prediction that the poor shall always be among the Children of Israel is thus more than fulfilled. In spite of their industry, frugality, thrift, sobriety and even philanthropy that aims at abolishing pauperism, there are more Jewish mendicants, paupers, dependents and defectives than social conditions would lead us to expect.

BIRTH RATE NOW FALLING

The deleterious influence of these dysgenic customs and habits of the Ghetto is proved in another way. In western Europe and in America, where the native Jews have discarded more or less these peculiar marriage customs, and where marriage is postponed till the contracting parties are prepared for the responsibilities they undertake; where the activities of the *Schadchen* are restricted or altogether spurned; and where the physical condition of the man counts for as much as his intellectual capacity, there has been observed a very decided and striking change in the physical and intellectual peculiarities of the people whose parents and grandparents have been inhabitants of the Ghetto. Their birth rates are low and are sinking; in fact, according to reliable statistical evidence available, the birth rates of the Jews in the large cities in central and western Europe are lower than those of any other religious group of people. Going hand-in-hand with this is also noted a striking improvement in their social and economic conditions. There are hardly any dependents, mendicants and paupers of Jewish faith whose parents have lived outside of the Ghetto in Germany, France, England, Italy, Scandinavia or the United States for two or more generations. Practically the Jewish dependents in western countries are of eastern nativity. But the proportion of physical and mental defectives has not been materially reduced among them, which is evidently one of the hereditary traits which cannot be easily eradicated.

While the economic conditions of the native western Jews are on the whole superior to those seen among their eastern co-religionists, this cannot be said about some other peculiarities which may be noted by a close observer. The well-known Jewish *Schnorrer* and itinerant mendicant has disappeared among them. But instead we find him now as a tramp or vagrant who does not at all differ from the non-Jewish people of this class. But this sort of vicious person, while parasitic and anti-social during his own life time, does not menace future generations as a rule, because he hardly leaves any progeny. It is from among these that we recently observed many of the Jews who are vicious, especially the drunkards, drug fiends, etc. They are now met with among the Jews in the United States. Had they remained under the influences of Ghetto life, they would undoubtedly have contributed to the dependent class and proliferated in the characteristic manner described above.

Another important change has taken

place among the Jews who have assimilated in western countries. They do not cultivate, nor do they support learning, scholarship and the arts to the same extent as they did in past generations. It can no more be said that the arts and sciences are their ideals; their aims appear to be more material, if not altogether sordid. In the United States Jewish philanthropy is very active in the direction of helping the poor and helpless and incidentally the pauper, the shiftless, the defective and the degenerate. But it is a striking fact that they make no effort in the direction of encouraging the exceptionally able or promising; there is no Jewish society to help the exceptionally bright, the talented and the promising among the Jewish youth in this city. In fact, the fund formerly available for such purposes has for some reason been diverted in other directions. I shall not enter into details about the ideals of marriage among the prosperous Jews in this city. All I shall mention is that marriage with a scholar is not given preference by rich parents, as was the case with their ancestors, but they look out for the possession of worldly goods by prospective husbands for their daughters.

The result is that while we have many prosperous and rich Jews in this country, there are very few *savants* whose ancestors have lived in the United States for two or more generations. Nearly all the workers in the fields of literature, arts and sciences, of Jewish faith or origin, were born in Europe, and even the great rabbis are not natives of the United States. This may be attributed in a great measure to the changes in the ideals of marriage which have taken place among the Jews in the United States during the last two or three generations. On the other hand, the intensive philanthropy, to which they still adhere, assures the perpetuation of many strains which are undesirable, to say the least.

From what I know of conditions in western Europe, it appears to me that they are drifting in the same direction. While among the Jews the support of the arts, literature and sciences is, on the whole, much more evident and substantial than among the Christians of the same social and economic status, it is not along eugenic lines, not having the tendency to improve the inborn qualities of future generations by the encouragement of marriage and parenthood of the intellectually superior. On the other hand, because they no more adhere to certain ordinances and superstitions about marriage, they no more encourage the marriage and parenthood of the physically and mentally strains to the extent their ancestors did. We may, therefore, expect that the number of defective Jews will in the near future not be higher among them than is found among the peoples around them.

CONCLUSION

I believe I have proved in this article that the extraordinary number of exceptionally capable and talented Jews, as well as the excessive number of physical and mental defective among them, owe their origin to a great extent to special and peculiar selective agencies. Their marriage laws and customs were effective in securing the augmentation of the favored stock, in increasing the number of individuals who are inherently above average in mental, intellectual and moral qualities. Giving preference in marriage to the scholar, encouraging him in his efforts, and often endowing him, the Jews have followed sane ideals in respect to marriage and procreation of favored stock. But some features of Jewish life, habits and customs have also been effective in enhancing the multiplication of the physically and mentally defective, and as a result we have at present an excessive number of persons who are of inferior stock among them. Especially must be emphasized their methods of distributing relief to the poor and afflicted as a dysgenic agency, responsible for a considerable proportion of the failures encountered among the modern Jews. However, with the recent adaptation of the mode of life, habits and customs of their non-Jewish neighbors, these peculiarities are gradually being effaced. Whether the loss thus sustained in the number of capable Jews is compensated by the decrease in the number of defectives depends on the point of view.

MULTIPLE BUTTON-BALLS

R. W. SHUFELDT, *Washington, D. C.*

ON PAGE 146 of the March, 1917, issue of *American Forestry*, I published a brief article on the "Sycamore or Buttonwood Tree Flower." It was illustrated by a cut showing that, in certain instances, there may be a short-peduncled flower-head or ball springing from one of the twigs of the tree, with another hanging below this, its peduncle being somewhat longer and apparently pressed into the upper ball at its proxi mal end. At the time this was published, I considered the condition rare, and so stated in my article. It caused many people to look up into the sycamores or plane trees, to ascertain if other specimens could be obtained. These were not long in coming. A specimen was sent me that had four balls to a string, the latter being formed by the peduncles in a straight line, the flower-heads or balls averaging about an inch apart. This specimen I published, with a brief account in the JOURNAL OF HEREDITY (July, 1917, p. 310), and this article brought me a good many more letters from correspondents who had observed similar strings of these flower-heads.

Then there was a lull in the correspondence which was rapidly showing me up as being a person who but rarely gazed heavenward—this at least being the case when I was either under or in the neighborhood of a plane tree. However this may be, the charge was to be brought home with still greater emphasis a little later on—indeed, it was not long on the way. The next surprise along this line of observation was handed me by Prof. Ralph L. Johnson, of Girard College, Philadelphia. During September, 1917, Professor Johnson sent down to me a box of button-balls, whereon the united peduncles exhibited all the way from *three* to *seven* to a string. These balls were very large, dark colored, and firm, and they certainly presented a most remarkable sight. Many of them were over an inch in diameter; in some cases they were side by side on the common string, and in one or two instances there were three balls with peduncles so short that the group were mutually tangent to each other. I made a number of negatives of these interesting specimens, one of which is reproduced here to illustrate the present article.

Professor Johnson has kindly given me permission to publish his two very interesting letters on this subject, they being dated September 17, 1917, and September 25, 1917, respectively; they are reproduced in this order below.

A TANDEM OF SEVEN

Girard College,
Philadelphia, Pa.,
Sept. 17, 1917.

Dr. R. W. SHUFELDT,
Washington, D. C.

SIR:

After reading your article in the July JOURNAL OF HEREDITY, Vol. xviii, Page 310, I examined the sycamore trees in Delaware Co., Pa., and find tandems of four, five, six and one of seven button-balls.

Under separate cover I have sent you a tandem of four and of *six* respectively on the same stem within three inches.

There is hanging in my study a spray with a peduncle with *six* balls, one of three, and two of four balls, all within seven inches upon the same branch. I have also a *peduncle* with *seven* button-balls; this I gathered from a six-foot step ladder. On another branch within two inches there is a tandem of *six* and another of *four* balls. I have gathered three peduncles of *five* balls.

The tree is about eight inches in diameter and forty feet high. It perhaps came from the West Chester Nursery. It is growing beside a much used road, in the center of a suburb of West Philadelphia. There are wonderful clusters of button-balls on this tree, often a score upon a branch no thicker than a small pencil.

Kindly advise if you wish any further facts or service. I have not examined the tree minutely—only from a six-foot ladder. There may be larger tandems than seven.

Yours most truly,
(Signed) RALPH L. JOHNSON.

SOME REMARKABLE STRINGS OF BUTTON-BALLS

The sycamore *Platanus occidentalis* or, as it should be called, plane-tree in America usually bears single flower heads popularly called button-balls. Investigation by members of the American Genetic Association has brought to light strings of them containing as many as seven. Professor Augustine Henry, the distinguished British authority on trees, suggests that these trees may be hybrids between *Platanus occidentalis* and *P. acerifolia*. Photograph (considerably reduced) by R. W. Shufeldt. (Fig. 6.)

Girard College,
Philadelphia, Pa.,
Sept. 25, 1917.

Dr. R. W. SHUFELDT,
3356 Eighteenth Street,
Washington, D. C.

DEAR SIR:

Your letter of Sept. 19th has caused me to send by separate package a collection of "tandems." These were selected Sept. 25, 1917, from the same tree described in my letter of Sept. 17, 1917.

While there are many plane trees here about, I have not noticed the multiple balls on any others. This tree, described in my former letter, is so full of balls that from the ground one is lead to believe that dozens are in a cluster.

On a spray twelve inches long you will find thirty balls arranged upon respective peduncles as follows, proceeding toward the tip of the branch: 3 - 3 - 5 - 5 - 4 - 5; also within four inches 4 - 7 - 5 or a total of sixteen balls; then within seven inches on another 4 - 5 - 5 - 6; and again within the same distance 4 - 5 - 6 - 5; then a peduncle with 4 balls beside one with seven balls; a tandem of five and a tandem of seven. This shows the balls grow odd and even to a respective peduncle.

Yours truly,
(Signed) RALPH L. JOHNSON.

I have requested Professor Johnson to obtain the history of this tree, if possible, and I trust he will succeed in doing so.

Should any reader of this article be so fortunate as to meet with a "tandem of eight balls," I would certainly like to hear of it. Seven on a string is the largest up to date.

Babies Not Banished from Washington Apartment Houses

Apartment houses are poor places in which to bring up children, but many children in large cities must be brought up in them, or not at all. The rule made by some apartment house managers, not to rent apartments to families with small children, is dangerous to eugenics, as encouraging childless families in a superior part of the population. It is therefore of importance to know how far such limitations are enforced.

The JOURNAL OF HEREDITY has investigated the policy of forty of the important houses of Washington. It is gratifying to find that thirty-nine of them do not object to children. As the demand for apartments in Washington greatly exceeds the supply, at the present time, an apartment house owner could hardly suffer any pecuniary loss if he discriminated against families with children, for there are plenty of childless families who would fill up his building. The fact that there is no discrimination against children cannot, therefore, be laid to a fear of losing money.

Only in one case, and that a relatively small apartment house, was it stated that families with small children would be barred. The manager explained that the same tenants had occupied the building for many years; that all of them were childless; and that the accidental presence of a uniformly childless set of tenants had led to his decision not to permit any intruders who would mar the harmony. The rule had recently been broken in one instance, he admitted, when a long-time tenant had violated the conventions by giving birth to offspring; but in view of the many years in which she and her husband had occupied the apartment he did not protest or evict them.

At this apartment house dogs were barred as well as babies. Of the whole list, twenty-nine apartment houses made no objection to dogs, if they were properly cared for; eleven refused to allow them.

Inquiry was made as to whether baby carriages were obliged to use the freight elevator. This was found uniformly to be the case, except in a few small buildings where there was no separate freight elevator.

Owners and lessees of apartment houses in the District of Columbia are to be congratulated on their attitude. It would be interesting to have similar investigations made in other cities, particularly in New York city, where it is commonly supposed that there has been much discrimination against babies on the part of real estate men.

AMERICAN SYCAMORES ARE POSSIBLY HYBRIDS

August 3, 1917.

TO THE EDITOR OF THE JOURNAL OF HEREDITY:

I am much interested in the articles on "Remarkable Button-Balls" in your July issue, page 310. The American buttonwood (*Platanus occidentalis*), bears usually one fruit ball, smooth on the outer surface, as the styles break off. The introduced tree, much planted in American cities (just as it is in European towns and cities), is *Platanus acerifolia*. The London plane or maple-leaf plane has two or three balls on each string, which are prickly to look at, as the styles persist. The tree has never been found in the wild state; and it is erroneously called by nurserymen "oriental plane" in the United States, and "occidental plane" in Europe. It is neither one nor other; but it is intermediate between the two wild species. The true oriental plane (*Platanus orientalis*) is never planted in streets, either in Europe or in the United States. It has deeply cut leaves, and bears usually six balls on each string; they are very prickly. This tree is much less vigorous, and is difficult to strike from cuttings, while the London plane is struck from cuttings very readily.

The most remarkable fact is that related in the article on the button-ball of the Morris Nursery Co. that the (so called) "oriental plane" is the only kind grown in their nursery, as it is superior to the American species. Considering that the American Buttonwood is the tallest, finest, and most vigorous broad-leaf tree in forests of the United States, will any one explain how it degenerates when planted in American towns? Will any one explain how the native species is inferior to the imported one; and why the latter is preferred?

It is possible that the abnormal specimens of *P. occidentalis* with three or four balls to the string, may be hybrids, as both *P. occidentalis* and *P. acerifolia* are frequently planted near each other in American cities. I should be very pleased to see dried specimens or branches with foliage and fruit-balls attached from any tree of *P. occidentalis* bearing an abnormal number of balls to the string. Two balls have been recorded frequently; but three or four balls seem to be unknown in this species.

Yours truly,

AUGUSTINE HENRY.

Royal College of Science for Ireland, Dublin.

The Relation between Race and Culture

SOCIO-ANTHROPOMETRY, an interracial critique. By B. L. Stevenson, Ph. D. Pp. 153. Boston, Richard G. Badger, 194 Boylston Street, 1917.

One school of sociologists thinks the manners and customs of a people are to be interpreted in terms of its racial heredity. The Russian and German civilizations, for example, differ because the Russian people contain Mongol blood which is not found in the limits of the modern German empire. Dr. Stevenson believes such a method of study is not justified. She discusses the culture of various European nations, then describes their racial make-up, and points out in conclusion that correspondences between the two are not exact. Moreover, she declares that the attempt to draw correspondences is not legitimate, since the two studies, anthropology and sociology, deal with such different material in such different ways. The question to which her book is devoted is an important one, and although her contribution is not conclusive, it is well to have the matter presented frequently. Numerous tables which she prints, giving anthropometric data for the races of modern Europe, will be found convenient for reference. by students.

INTELLIGENCE OF IMMIGRANTS

Dr. H. H. Goddard Finds Indications That Large Part of Those Who Arrive in the Steerage are Feebleminded—Low Grade of Intelligence May Possibly Not Be Hereditary in This Case

THAT the average steerage immigrant has a low grade of intelligence—perhaps is even feebleminded—is the conclusion suggested by H. H. Goddard, director of research at the Training School, Vineland, N. J. Dr. Goddard and his assistants examined six small groups arriving at Ellis Island. Two of the groups—twenty Italians and nineteen Russians—were selected because they appeared to the investigator to be feebleminded. The other four groups were selected as being representative of their respective nationalities, and comprised 35 Jews, 22 Hungarians, 50 Italians and 45 Russians. In every case the immigration officers had previously culled out all whom they recognized as mental defectives. Very obviously high grade intelligent immigrants were also passed by. Those examined are probably a fair sample of the bulk of the steerage immigration.

Numerous tests were given. "Each test taken by itself seems to indicate a very high percentage of feeblemindedness. There is no exception to this." Little attempt is made by Dr. Goddard to establish the exact amount of feeblemindedness, because of uncertainty as to the proper standards to be used for scoring some of the tests. With the Binet scale, only two of 148 immigrants scored as high as twelve years, which is usually taken as the dividing line between feeblemindedness and normal intelligence in adults. When liberal allowances are made for every possible case where the scoring may be too high, it yet appears that more than half of these immigrants test feebleminded, and none shows superior intelligence. Dr. Goddard[1] discusses the results as follows:

"Doubtless the thought in every reader's mind is the same as in ours, that it is impossible that half of such a group of immigrants could be feebleminded, but we know that it is never wise to discard a scientific result because of its apparent absurdity. Many a scientific discovery has seemed at first glance absurd. We can only arrive at the truth by fairly and conscientiously analyzing the data.

"First it should be noted that the immigration of recent years is now longer representative of the respective races. It is admitted on all sides that we are now getting the poorest of each race. This makes them a highly selected group from the start. For example Salmon says of every 1,000 Polish immigrants all but 103 are laborers and servants.

"Of the twenty-two in the Jewish group who classify as feeble-minded, nineteen, or 60% of the whole, classify as morons. It will be recalled that the English College of Physicians define a moron (what they call feebleminded in the specific sense) as 'One who is capable of earning his living under favorable circumstances but is incapable from mental defect, existing from birth or from an early age, (*a*) of competing on equal terms with his normal fellows, or (*b*) of managing himself and his affairs with ordinary prudence.' We have now to ask the question, is it possible or reasonable that 40% of the immigrants in such groups as we have examined are morons according to this definition? Let us examine critically the definition, and bring to bear upon the problem what we know of the nature, character and work of this class of immigrants.

"First, the definition admits that they are capable of earning a living

[1] Goddard, Henry H. Mental Tests and the Immigrant. *Journal of Delinquency*, ii, pp. 243–278, Sept., 1917.

under favorable circumstances. Favorable circumstances may be construed to mean an opportunity to work at any possible kind of labor which will bring sufficient remuneration to supply food, clothing and home. It is easy to be seen that the kind of labor and the remuneration necessary for support will depend very largely upon the character of the living that is needed, that is to say, the amount and quality of food, the quality of clothing, and the kind of domicile. One familiar with the requirements of the average immigrant will not hesitate to admit that the conditions under which he is willing to live are so relatively simple that if he is willing to work at all it is not difficult for him to make a living.

"The second clause of the definition says that he is incapable ('because of mental defect,' etc.) of competing on equal terms with his normal fellows in the struggle for existence. Again a consideration of the immigrant's situation shows us that he, on the average, does not have what is meant in the definition by competition with his normal fellows. As a result of his early training, and the conditions under which he has lived in his own country he is willing to do work that no one else will do. There is therefore no competition, properly speaking.

"The last clause says that he is incapable of managing his own affairs with ordinary prudence. It is not at all impossible that it is literally true that the 40% do not manage their own affairs with ordinary prudence. In many cases the affairs are managed for them, as surely and thoroughly as for any group of dependents among us.

"We may look at the problem from another standpoint. The writer has already suggested that the problem of the care of morons might be solved if the public could be educated to recognize these people as morons, and to treat them with that care and consideration which their mental makeup requires. Morons as a class, if taken early and trained carefully and so kept from becoming vicious and criminal, could be successfully employed if the employer understood them, and realizing that they are children, excused their faults and mistakes, was watchful of, and patient with them.

TREATMENT OF IMMIGRANTS

"Now strangely enought it seems that this is exactly what we often do for the immigrant, not because he is a moron but because he does not know the customs of the country. He is excused because he does not understand the language. His every act and movement is more or less closely supervised because he is a foreigner. In a large percentage of the cases he goes at once, when he lands, to his own group. They protect and care for him, partly through racial pride, partly through common humanity, extending to him the care and oversight and patience which we have just mentioned. Contrast this with the intelligent, independent immigrant!

"There are no statistics available to prove or disprove the truth of these theories, but certainly it cannot be denied that this is literally true of a great many immigrants. It will doubtless be said by some reader that this is a libel upon the immigrant; that on the contrary he is a keen, sharp, energetic worker; that much of our population has been immigrant. It seems hardly necessary to suggest in reply that we are only speaking of 40% of the immigrants and that, too, of the immigrants who come in the steerage, whereas many immigrants come second class or even first, and that those who make a success and become prosperous citizens are the ones we most often meet, whereas the great mass are entirely beyond the ken of the average citizen. He knows nothing of them or how they live.[2] It may be but proper to add also that very few people realize what the moron is. To many people it is a simple formula; moron means feeble-minded, feeble-

[2] For the difference between the "old immigration" and the "new immigration" which commenced just after the Spanish-American War, consult Salmon, Thomas W. "Immigration and the Mixture of Races in Relation to the Mental Health of the Nation," Chapter vi of White & Jelliffe, *Modern Treatment of Nervous and Mental Diseases*. Philadelphia, 1913.

minded means imbecile or idiot as is known in the community. This is not the fact. The moron is a person of mental level of from 8 to perhaps 12 years. He is capable of earning a living under favorable circumstances. He many times gets along in the community because someone looks after him and manages his affairs for him, and sees to it that the competition with others of the community is not too severe for him. It must be understood that we are not claiming that we have proved that 40% of these immigrants are morons, but we do feel that the foregoing consideration to a considerable extent removes the absurdity which stood in our way of accepting as fact that a surprisingly large percentage of immigrants are of relatively low mentality."

THE PROBLEM OF HEREDITY

What of the eugenic aspect? "Morons beget mornons, and while these people themselves, as we have already said, have been trained in their own country through the vicissitudes of their life and environment so that they are fairly safe people in our community, yet when they marry and have children the case may be entirely different."

"Here then is a vital question which obviously our investigation does not answer. Are these immigrants of low mentality cases of hereditary defect or cases of apparent mental defect by deprivation?" There are no data on the point, but Dr. Goddard thinks that to a considerable extent the second explanation may hold good. "To mention only two considerations: First, we know their environment has been poor. It seems able to account for the result. Second, this kind of immigration has been going on for twenty years. If the condition were due to hereditary feeblemindedness we should properly expect a noticeable increase in the proportion of feebleminded of foreign ancestry. This is not the case." While the low intelligence of immigrants is not a cause for national rejoicing, it may therefore be less dangerous racially than it appears at first sight.

No Meeting of the Association to be Held This Year

Although there will be no meeting of the American Genetic Association this year, for the presentation of papers, members of the A. G. A. will find much to interest them in the programs offered by other societies during the holiday meetings in Pittsburgh. The Botanical Society of America will place the genetical papers of its program on Monday morning, December 31, and in the afternoon will present an invitation program including the address of the retiring president of the Society, Professor R. A. Harper, of Columbia University, an address entitled "Plant Breeding for Disease Resistance," by Dr. W. A. Orton, of the Bureau of Plant Industry, and an address on "Homoplasy and Longevity," by Dr. G. R. Wieland, of Yale University. Thus the entire program of Monday will be of great interest to geneticists generally. Plant breeders, members of the A. G. A., but not of the Botanical Society of America, may present papers at the morning session if introduced by a member of the latter society. Any member of the Plant Breeding Committee of the A. G. A. will be glad to arrange for the presentation of papers. The program of the American Society of Naturalists includes a group of invitation papers in genetics on Tuesday morning, and in the afternoon a symposium on "Factors of Organic Evolution."

AN AVOCADO MONSTROSITY

ROBERT W. HODGSON

University of California, Berkeley, Cal.

WITH the rapid extension of avocado planting in California and the consequent demand for trees, nurserymen have had occasion to raise many thousands of seedlings during the last four or five years. Among such a large number naturally some abnormal forms have appeared such as albinos and dwarfs, and among others a few teratological monstrosities have been reported. The latter usually take the form of fasciation in which terminal nodes have become expanded, presenting a ridged, flat stem of greatly increased width upon which normal buds are borne. Among such peculiar forms none more striking has been reported than that pictured in Fig. 7 which was found in a lot of Grande seedlings in the University greenhouse. This particular case does not exhibit the usual characteristics of fasciation and seems worthy of being put on record.

The peculiar growth was first noticed when the seedling was about seven months old and is still present. Although the first leaves were shed some time ago, the new growth exhibits the same peculiarity. The malformation consists of the hypertrophy of the terminal cluster of leaves together with several adjacent nodes. The leaves are markedly modified both in form, size, and consistency. The size is greatly reduced, and the terminal node is so shortened that the leaves are crowded together much as in the case of a brussels sprout. The consistency and form of the leaves are so modified that the general appearance is that of a much corrugated, imbricated mass of white fleshy tissue possessing a shiny surface.

Very careful examination revealed no traces of the presence of insects or of wounds caused by them. Microscopical examination has failed to show any indication of fungi. The general appearance of the modified leaves suggested a possible connection between them and the large fleshy cotyledons, but study has failed to confirm this. The cotyledon tissue was found to contain very large quantities of starch, some sugar, and notable amounts of oil. The abnormal tissue contained little of these but was fairly rich in protein. The cells of the cotyledon tissue were found to be heavy walled, larger, and in other ways distinctly different from the spongy pith-like, thin walled tissue of the modified leaves. Sections through such leaves showed that they lacked the palisade layer and spongy parenchyma entirely and possessed but a rudimentary vascular system. A few cells containing chloroplastids were found scattered here and there.

The effect of the abnormality on the growth of the seedling has been such that a shoot from a node further down has developed and has taken the ascendency. This fact together with the fact that all subsequent growth of the affected nodes has been of the abnormal type seems to indicate that the stimulus or change resulting in the peculiar growth has probably not been of a momentary nature such as the sting of an insect. To be sure, it may be possible that the abnormal tissue in this case is analagous to new forms which have been produced by the injection of certain chemicals into the ovaries of plants as established by Lloyd and MacDougal, but in this case the change has been purely somatic.

Examination of the literature does not discover much that is helpful in classifying this peculiarity and indicates that our present knowledge as to the cause of teratological forms is quite unsatisfactory. Thorough study of such forms might help unravel the mystery concerning the causes leading up to bud-mutations.

PECULIAR GROWTH ON AVOCADO SEEDLING

This peculiar growth appeared on a Grande seedling seven months after planting. All the subsequent growth of the infected nodes has been of the same nature. No traces of insect injury or fungus parasites have been found. What has caused this change? May it not be of the same nature which results in a bud-mutation? (Fig. 7.)

A BOTTLE-NECKED LEMON

LEONHARDT SWINGLE, *Riverside, Cal.*

THE work of A. D. Shamel on bud sports and their occurrence in the citrus family has directed much attention recently to this class of variation. It is now recognized that such sports are more frequent and are of greater importance from the standpoint of improving and standardizing varieties than has been recognized before this time. A slight examination of almost any citrus orchard will usually disclose many cases of sporting limbs and demonstrate the need of further investigations on this subject.

The writer recently found in a Eureka lemon orchard near Corona, Cal., a tree bearing a large and very unusual limb sport. This branch has been overlooked in pruning until at the present time it comprises a large part of the tree. The whole limb is of a peculiar type as shown by the fruit, leaves, and habit of growth. It is very different from the remainder of the tree, which is to all appearances a normal Eureka lemon.

The fruit, as shown by the accompanying illustration, is at once distinguished by its long, bottle-like neck and its small size. It is a lemon but with the shape of a gourd. The limb is sufficiently productive, if the crop it now bears can be taken as a criterion, but lemons of this peculiar gourd-like shape are not worth much in the market today. This large limb and its crop of worthless lemons may be considered as so much detriment to the tree for it is occupying space and using plant food that might as well be used in the production of good fruit. The limb is a boarder instead of a producer.

As brought out in the illustration, the leaves of this limb are very different from those of the normal Eureka lemon. They are narrow and sharply pointed, resembling willow or peach leaves more than those of the remainder of the tree. These narrow leaves give a distinctive appearance to the side of the tree where this limb is located, although this difference in appearance is emphasized by the more slender and dense twig growth.

The narrow pointed leaves and "bottle-neck" fruit constitute a distinct and unusual type. There is no transition between the normal part of the tree and the sporting branch. There is a small twig on the sporting limb near its base, that bears normal Eureka lemons, while a short distance above is another twig bearing the "bottle-neck" fruit. Somewhere between the two twigs the change occurred from the normal to the freakish fruit.

The discovery of this limb encouraged the writer to make a search for others of a similar nature on other trees of the same grove. Several have been found varying in degree from large limbs similar to that described, to mere twigs.

It is interesting to note that there is an apparent correlation between the "bottle-neck" fruit and the narrow, pointed leaves. Where the leaves are narrow and pointed, the fruit is usually of this pronounced "bottle-neck" shape. This apparent relationship indicates that the value of a branch might sometimes be judged by its leaves, when pruning or cutting buds.

The discovery of such limb sports while still twigs makes it possible to cut them out before they reach a large size and lower the value of the trees by their production of worthless fruit. It is, of course, best to grow only trees which do not produce such freakish limbs. The next best thing is to keep such limb variations in trees under control by cutting them out with the pruning knife so that their erratic tendencies may be checked so far as possible.

BOTTLE-NECKED AND ORDINARY EUREKA LEMONS

A limb-sport was found in a lemon tree, which gave rise to lemons of the peculiar shape shown at the top of the photograph. The effect of the change was not confined to the fruit, but extended also to the leaves, which are much narrower than ordinary. Normal fruit and leaves, borne by the unchanged part of tree, are shown at the bottom of the photograph. The marked change in leaves and fruit is a good illustration of the fact that variability is *correlated*, and that one part of an organism cannot be markedly changed without producing changes in various other parts. (Fig. 8.)

The Number of Unmarried Persons in the United States

There are 17,000,000 celibates in the United States, according to a statement which has been going the rounds of the press, after originating in a magazine article on the sex question. Examination of the census schedules for 1910 indicates that this figure includes all males over 20 and all females over 15. A calculation based on such age limits is misleading, but the actual facts are quite striking enough. Persons 35 years of age or over are relatively unlikely to marry, and it seems fair to base computations on that age. They show, then, that there are nearly 2,000,000 unmarried men in the population, and about 1,250,000 unmarried women. There are about 1,500,000 unmarried women between the ages of 25 and 34, and a considerable part of these are certain never to marry. The celibacy of these millions is, from a eugenic point of view, not wholly to be deplored. While the number includes many potential fathers and mothers of a desirable character it is probable that, on the whole, these life-long celibates are eugenically inferior to the married population.

Pure-lines of Bacteria

From studies of bacteria, L. J. Cole and W. H. Wright conclude that descendants of a single cell constitute a pure-line, which cannot be modified by selection. Mutations occur in such lines, both spontaneously and in response to external stimulus. Much of the variation in bacterial cultures is attributable to isolation and perpetuation of certain pure-lines and the elimination of others. The study is reported in *Jour. Infect. Diseases*, 19, pp. 209–221.

COLOR INHERITANCE IN MAMMALS

VII, The Horse—Studbooks Have Afforded Data for Many Investigators—Many Different Pairs of Allelomorphs to be Found in All Combinations —Some Interesting Cases in Hybrids

SEWALL WRIGHT
Bureau of Animal Industry, Washington, D. C.

HURST[1] showed as early as 1906 that chestnut differs from the darker colors by a simple Mendelian recessive and this result has been confirmed by all later workers. Most of the remaining factors were rapidly worked out by Wilson,[2] Sturtevant,[3] Anderson,[4] Wentworth,[5] and others with results largely in harmony. There still exists, however, one very important difference of opinion. Most of the factors were worked out simply in opposed pairs of characters and little attention has been paid to the relations of the different pairs to each other. Two different theories as to these relations have arisen. The present paper follows in the main the view very clearly presented by Wentworth and probably most generally held, viz., that there are many different pairs of allelomorphs which may be found in all combinations. Wilson,[6] on the other hand, holds that most of the factors belong to the same series of allelomorphs. Thus he considers gray, dun, bay, black and chestnut to be such a series of what he calls polygamous factors. This series is of a very different kind from the nine sets of multiple allelomorphs known among rodents. In the latter, the factors produce a graded series of effects when arranged in the order of dominance, a fact which suggests that in these cases we are simply dealing with different levels of potency of some one genetic as well as physiological factor. Wilson's series cannot possibly be arranged in such a way. It is difficult to conceive how variations in one physiological factor could produce such diverse effects. The series, may, indeed, be compared with Nabour's[7] series of color mutation in grasshoppers and perhaps with the condition of complete linkage found in factors of the same chromosome in the male *Drosophila*,[8] or the female silkworm.[9] If Wilson's hypothesis is correct, it is easiest to suppose that the factors are related merely in a mechanical manner in the germ-cells and not as variations of the same factor.

BAY-HORSE—GRAVMAB

$1a_1$	G, g	G—gray
	R, r	R—roan
$1a_2$	V, v	V—piebald
$1a_3$	—	
1b	D, d	D—dun
—	M, m	hhmm—sorrel
$2a_1$	A, a	a—black
$2a_2$	—	
$2a_3$	—	
2b	B, b	b—chestnut

Classification explained in paper on the mouse, JOURNAL OF HEREDITY, 8:373, August, 1917.

FACTORS APPEAR INDEPENDENT

However, there is considerable evidence in the horse which appears to the writer to favor decidedly the hypoth-

[1] Hurst, C. C. 1906. *Proc. Roy Soc.*, 77:388.
[2] Wilson, J. 1910. *Sci. Proc. Dub. Soc.*, 12:331.
[3] Sturtevant, A. H. 1910. *Biol. Bull.*, 19:204; 1912. *Jour. Gen.* 2:41.
[4] Anderson, W. S. 1913-1914. *Amer. Nat.*, 47; *Ky. Sta. Bull.*, 180:121.
[5] Wentworth, E. N. 1914. *Zeit. f. Abst. u. Ver.*, 11:10.
[6] Wilson, J. 1916. A Manual of Mendelism. 152 pp.
[7] Nabours, R. K. 1914. *Jour. Gen.*, 3.
[8] Morgan, Sturtevant, Muller and Bridges, 1915. The Mechanism of Mendelian Heredity.
[9] Tanaka, Y. 1914. *Trans. Sapporo Nat. Hist. Soc.* 5.

esis of independent factors instead of complete linkage. There are first certain considerations based merely on appearances. Wilson himself grants that roan is inherited independently of the others, on the ground that the roan pattern obviously can be combined with any of them in effect. Bay, blue and strawberry roans are all common, and Wilson mentions roans which later turn gray. Doubtless he would consider piebald as due to an independent factor for a similar reason.

But it is also well known that grays may be any color at birth, and also in duns, varieties are recognized which appear to be the dilute forms of bays, blacks and chestnuts respectively. These are the dark-maned duns, the mouse-colored horses and the creams. Even among chestnuts, differences homologous to that between bay and black may be visible in the red and liver-colored chestnuts, though this does not appear to have been tested genetically.

The genetic evidence for the theory of independence is thoroughly satisfactory in regard to the factor which changes bay to black (A,a), and that by which chestnut, differs from either (B,b). In breeds in which bay is more common than black more chestnuts should possess factor A than a and chestnut by black, both recessive to bay, should yet produce many bays, each parent supplying the dominant factor which the other lacks. This turns out to be the case. Thus Anderson found 111 chestnuts, 83 blacks, 20 browns (generally equivalent to dark bay) and 124 bays from chestnut by black among Kentucky saddle horses. In these quite extensive results 42% of the offspring are inexplicable on Wilson's theory under which neither blacks nor chestnuts could ever possess the dominant bay factor.

In the case of gray or dun it is more difficult to get conclusive evidence, as it is necessary to find individual gray or dun sires which showed themselves to be double heterozygotes in particular kinds of matings. Gray and dun are not among the commonest colors in most breeds and stud books, moreover, are known to be none too accurate in regard to colors, so that individual cases must be used with caution. Wilson[10] gives the record of twenty gray Thoroughbreds which had at least one chestnut foal from a chestnut mare and were therefore GC on his hypothesis. These stallions produced from chestnut mares 94 grays, 15 bays, 1 black and 61 chestnuts. The presence of so many bays and one black can hardly be ascribed to errors although it must be admitted that they are not as numerous as one would expect on the hypothesis of independence. The sire which seems most certainly to be a double heterozygote, GgBb, is Gray Frairs, with 15 grays, 3 bays and 4 chestnuts from chestnut dams. Possibly partial linkage between G and H may exist. In this case, most grays which produce chestnuts at all would be of formula GBgb and so produce an excess of chestnuts. At any rate it seems clear that gray can transmit both chestnut and bay.

GRAY, ROAN AND PIEBALD

Turning to the list of factors, it may be said that the factor for gray has been certainly demonstrated. A number of gray stallions are known which are homozygous, producing only grays from mares of all colors. Most grays are naturally heterozygous and produce very close to the expected 50% gray, 50% of other colors, when mated with other colors. Factor G has been placed in class $1a_1$ as a dominant factor which inhibits color regardless of its quality, but its mode of action is peculiar. Grays generally show little or no white when born, but gradually become whiter as they grow older, white appearing early especially on the head.

The dominant factor for roan has also been clearly demonstrated, both homozygotes and heterozygotes being known. It is more typical of class $1a_1$ than is the factor for gray. The mixing of white hairs with colored ones occurs regardless of the color of the latter. The head and lower limbs are usually

[10] Wilson, J. 1916. *Loc. cit.*

not much affected, while the rest of the coat shows an even mixture free from the dappling of grays. There is no change with age. The relations of gray and roan have not been thoroughly cleared up. Wentworth has given data which show that roans may transmit gray but that grays cannot transmit roan. That is, horses of formula GgRr are roans in the stud book. *A priori* this seems a very remarkable result. It appears to mean that the gray factor which whitens animals which would otherwise be solid colored is somehow inhibited in the presence of another factor with a whitening effect. The explanation, however, is probably, as Wilson suggests, that the real distinction between roans and grays is not generally recognized. A horse which is born chestnut and turns gray is called a gray, but one born a chestnut roan is called a roan even though it later becomes white, the latter effect being looked upon as associated with the roan effect in such cases. Thus roans should probably be divided into two classes, those which hold their color (ggRr) and those which become gray (GgRr).

Mendelian inheritance has been clearly established in the case of the pattern of skewbald and piebald horses. The pattern appears to be quite similar to the piebald patterns of rodents in character and so is classed with them here in class $1a_1$. It is, however, a dominant. Self by self, seems to give only self (except for small markings), while pied by self was found in a tabulation by Walther[11] to give 109 pied to 115 self. This ratio indicates as one would expect that practically all piebalds are heterozygous. Solid white horses are occasionally found, the white sometimes even invading the eyes. Possibly these may be homozygous for the piebald factor.

Horses with white markings on head and feet are very common but do not have the piebald factor. Walther could find no simple mode of inheritance. They seem to be comparable with the Irish rats which Hurst found to be free from the hooding factor.

Bay is agreed by all writers to be a simple dominant over black. A dominant inhibitor of black is involved which can best be compared with the agouti factors of the rodents and is therefore put in class $2a_1$.

Brown is a color which has caused much trouble. Sturtevant believed that browns were generally heterozygotes between black and bay. Anderson considers it to be a composite term at least among saddle horses, including two distinct varieties genetically, dark bays and rusty blacks. Most browns appear to have the bay factor.

The factor by which chestnuts of all shades differ from blacks and bays is somewhat difficult to classify. An ordinary chestnut shows little but red and might be compared with the recessive red of guinea-pigs. But liver chestnuts show a larger amount of dark pigment which, however, is brown, not black. Thus the factor may well be placed in class 2b with the chocolate factor of rodents. Appearances suggest that livers differ from ordinary chestnuts in the same way that blacks do from bays, *i. e.*, in having factor a in place of A, but the writer knows of no data which bear on this point.

GRADES OF INTENSITY

There are many grades of intensity in horses, especially noticeable in chestnuts, which remain to be analyzed. A dominant general dilution factor by which buckskin duns, mouse-colored horses and creams differ from bays, blacks and chestnuts seems best established. Although dominant, it is put for the present in class 1b, the factors of which it most resembles in effect. Besides this, Wentworth has shown that there is a recessive factor which is responsible for the difference between light-maned sorrels and those with dark manes, a result which has been confirmed by McCann.[12] Light-maned liver chestnuts which seem to have this factor are not uncommon. It may also

[11] Walther, Ad. 1913. *Zeit. f. Abst. u. Ver.* 10:1.
[12] McCann, L. P. JOURNAL OF HEREDITY, 7: 370–372.

be put in class 1b, but so far its effect in bays and blacks has not been worked out.

COLOR INHERITANCE IN HORSE HYBRIDS

There are a number of curious facts in connection with horse hybrids which need more investigation. Gray and piebald remain dominant in crosses between horses and asses. In a cross made by Ewart[13] between a zebra and piebald mare the hybrid showed no trace of the piebald pattern, but the dam may have been a heterozygous piebald. It is often held that dun is the ancestral color of the horse, the wild Przevalski horse showing an approach to this color. Zebras also show a pale cream ground color with black stripes and would be expected to have factor D. Nevertheless, when crossed with chestnut, black, or bay horses, the offspring approach bay rather than dun. If the zebras contain the same factor as dun horses, dominance is reversed. Finally, another apparent reversal of dominance must apparently take place in the production of chestnut mules, as anything like this color is unknown in donkeys and factor b is recessive in horses.

Effects of Factor Combinations

	gr	gR	Gr	GR
DAB	Dun	Dun roan	Gray	Gray (born roan)
DaB	Mouse	Mouse roan	Gray	Gray (born roan)
DAb	Cream	Cream roan	Gray	Gray (born roan)
Dab	Cream	Cream roan	Gray	Gray (born roan)
dAB	Bay	Bay roan	Gray	Gray (born roan)
daB	Black	Blue roan	Gray	Gray (born roan)
dAb	Chestnut	Strawberry roan	Gray	Gray (born roan)
dab	Chestnut (liver?)	Strawberry roan	Gray	Gray (born roan)

The Occurrence of Seven-Leaved Clover Leaves

Apropos of De Vries' achievement in producing a seven-leaved clover by breeding from a four-leaved strain, sometimes cited as proof of the cumulative effect of selection, I wish to say that I at one time found in the field a plant which closely resembled De Vries' production, it having one leaf with seven leaflets, one with six, a goodly number of fives, and the remainder nearly all four-leaved. There were only a few normal leaves on the plant.

This would seem to place De Vries' achievement on a par with that of Luther Burbank in producing a scarlet California poppy from a yellow one having a red stripe. According to W. J. Spillman, such scarlet poppies have been found growing wild, and Burbank's achievement might therefore be ascribed to the untangling of hereditary characters already in existence.

As this clover plant of which I speak was found in late autumn and had disappeared the following spring, no seed could be saved, and as my specimens were not preserved with sufficient care I now have nothing to show for it but an opinion that if the matter were made the subject of sufficiently wide inquiry, other such plants would be brought to light, this discovery being rendered probable by reason of the popular interest taken in four-leaved clovers.

H. D. Tennent,
McConnelsville, Ohio.

[13] Ewart, J. C. 1899. The Penycuik Experiments.

THE DUCHESS APPLE IMPROVED

Sport with Brilliant Red Color Appears to be Due to Bud Variation—Other Apple Varieties that Have Originated in a Similar Way[1]

M. J. DORSEY

State Agricultural Experiment Station, St. Paul, Minn.

A STRIKING variation from the usual type of the Duchess apple has been found by William Bardwell in his orchard near Excelsior, Minn. Since variations so marked are relatively rare, a statement of its probable origin and the nature of its departure from the variety type will be of interest to horticulturists and geneticists.

Duchess[2] is an old and well-known variety, "being one of the four pioneers among Russian apples in America"—imported by the Massachusetts Horticultural Society about 1835. A comparison of the new type with it will be made only with reference to the principal fruit and tree characters in order to set forth clearly the nature of the sport.

In tree and leaf characters Duchess and the sport are identical. Both bloom and ripen at the same time. While their relative keeping qualities have not been experimentally tested in storage, judging from the general characters of the sport, there would probably be little, if any, difference. In such fruit characters as size, shape, cavity, basin, calyx lobes and stem, the sport runs parallel with Duchess. The russet markings of the cavity and the dots are similar in size and distribution to Duchess. The flesh characters are also quite similar, the sport being slightly less tart in flavor, if there is a difference, but both should be given the same rank as to quality. The core lines, core and seeds are so nearly alike as to be indistinguishable.

So much for the points of resemblance! The outstanding characteristic difference of the sport compared with Duchess is the deeper red and more solid color of the skin. The typical color of Duchess is a pale yellow background more or less covered with irregular dark red streaks overlying lighter irregular blotches. The deepest color of Duchess sometimes approaches a solid red, but in many localities this variety lacks color to a fault. The sport has the same yellow background and is covered with a solid, dark red color on exposed parts, shading at the apex into a lighter red overlaid with darker streaks. In some better colored specimens there is nearly a solid but quite thin purplish red color at the apex end. Apples of the sport not so well colored have the dark red streaks characteristic of well colored Duchess. The general appearance of the sport in a box pack is decidedly more red. Another point of economic importance is the slightly tougher skin of the sport, although the skin of both is, on the average, made up of three thick-walled cell layers before the larger pulp cells are reached. However, the skin of the sport is not so easily broken and as a result the fruit stands up better when baked.

Since the history of this variation is known only in part, what reason is there for speaking of it as a bud sport? The tree was purchased about fifteen years ago from a local nursery and was supposed to be Duchess since it came in a

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[1] Published with the approval of the Director as Paper No. 89 of the Journal series of the Minnesota Agricultural Experiment Station.

[2] While this variety should be called Oldenburg, according to the rules of the American Pomological Society, it is little known in the Northwest by this name.

RED SPORT OF THE DUCHESS APPLE

The Duchess (often called the Oldenburg) is one of the best known American apples. A variation with a much richer color than the original has appeared, and may be even more popular in many markets. The Duchess (above) and the red sport (below) are shown natural size in the illustration. (Fig. 9.)

bundle of that variety. All branches bear the highly colored fruit which makes it impossible to determine with certainty whether it is a sport. It was bought for a grafted tree but since there is no evidence of a graft union at the base as far as can be determined by external appearance when the dirt is thrown back as far down as the roots, this point cannot be definitely settled. The seed of Duchess is used, when available, by nurserymen, to obtain seedlings, so that it is possible that seedlings of Duchess, open or cross pollinated, were used for stock on this particular occasion. Its origin as a seedling, however, presupposes that if a graft was placed on this particular stock it did not grow. The lack of vigor characteristic of most self-fertilized seedlings is not apparent in this case. So it appears that if this new type is a seedling it is so remarkably near Duchess in so many characters that it may be regarded as a combination of rare occurrence.

RETAINS CHARACTER WHEN GRAFTED

If this new form is not a seedling, the other possible method of origin is as a bud variation. If this new form originated as a bud variation it may be that this is the only tree of its kind, or others may have been grafted from the same source, providing there was sufficient growth from the original bud which varied. When topworked the sport retains its original characteristics.

If this is a bud sport from Duchess it is a good illustration of a variety being improved by this means. If it is a seedling this does not detract from its value. By carefully watching all varieties for such variations it may be possible to have different types within the variety which may vary in important features. The higher color of this sport over Duchess—certainly its nearest relative if not its parent—will make it a favorite in that class of trade where higher color is desired.

Sports similar to this have been of relatively frequent occurrence in the apple. A single limb, but not so highly colored as the Bardwell sport, was found on a Duchess tree in the University of Minnesota Experiment Station. Collamer arose as a sport from the Twenty Ounce, and differs from the parent variety chiefly in the higher color. Hitchings arose in the same way from Twenty Ounce, and is more highly colored than Collamer. Banks is another sport of a similar nature which arose from Gravenstein and differs from it primarily in color, being sometimes called the Red Gravenstein. Following this precedent, Red Duchess would be an appropriate name for the Bardwell sport.

While the origin of the new type herein described cannot be ascribed with certainty to a bud sport, on *a priori* grounds the evidence points that way. Since it has been equal to Duchess in productiveness and has shown the characteristic hardiness and vigor of this variety, it will be evident that there is a place for this Red Duchess where greater color is desired in an apple of this type.

Low Fecundity of Intellectual Negroes

Eugenics finds the same problem in the Negro race in America as in the white race, says Dean Kelly Miller of Howard University in the July issue of *The Scientific Monthly*. He finds that fifty-five members of the academic faculty at Howard have an average of 0.7 of a child each. While these families are not completed he is persuaded that the ultimate figure cannot be higher than two children per family—a number not sufficient to replace the parents. The families from which these fifty-five faculty members came average 6.5 children each. This low fecundity of intellectual Negroes is general, Dean Miller says. It is partly due to the long period of education which a Negro must have if he is to rise, partly to the high standard of living which he feels it necessary to maintain, and partly to the fact that some sensitive Negroes, feeling that their race is stigmatized as inferior, prefer not to have any children who must bear the burden of race prejudice.

A GOLDEN VARIETY OF RYE

JUAN WILLIAMSON

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IN THE winter of 1914, while walking over a neglected field that had been sown with rye the previous year, I noticed many volunteer plants of this cereal, amongst them one with a distinct yellow foliage. I was curious to know if the plant was healthy or if the yellowness was due to some disease, so carefully lifted the plant and, after dividing it into three, had them planted on a small plat among some wheat experiments where they would be taken care of.

Owing to the fact that rye is almost entirely self-sterile it was necessary to grow a few normal plants by the side of this yellow one to insure the setting of some seed. With the idea of getting, by chance, one or two self-fertilized seeds, five ears were bagged in the usual way, but not a single seed was formed. The other ears, that were left to nature, set almost 100% of their flowers. This seed was harvested and sown the following year, 1915, on a plat 3 meters square, and as was expected practically all the resulting plants were normal green. One, however, was yellow like the mother plant, evidently self-fertilized. All the ears of this yellow plant were bagged and the result was the same as the first year, no seed being formed. The normal green plants gave a fair amount of seed which was sown the following season on a 10 by 10 meter plat. Again, as was expected, this seed produced green plants and yellow plants in the proportion of three of the former to one of the latter. All the yellow plants were dug out and planted on a small plat by themselves, and the green ones were destroyed before flowering time to prevent the pollen of green plants from fertilizing the flowers of the isolated yellow plants.

Unfortunately the locusts came while the plants were still young and tender, and destroyed the greater part of them, the result being that very little seed was obtained.

However, this amount of seed is quite enough to demonstrate that the yellowness of the plants is a true recessive character, and that when yellow plants are grown together a good distance from any green plants, and their seed harvested and sown, their progeny are all yellow, as is proved by our 1917 plat.

Now arises the question: How does the yellow plant lose its greenness? Is it due to susceptibility to some bacterial disease brought about by the dropping out of a factor the presence of which makes the plant ordinarily immune, or is it simply a case comparable with the "dilute" forms of hair color in animals, as, for example, the "blue" of the cat where the black pigment granules, scattered in the hairs, are so spaced out as to give the optical effect of "blueness." Here, the chlorophyll plastids are presumably so spaced out in the tissues of the plant that the optical effect is yellowness.

A microscopical examination has not been made to disprove the first theory, but, until the contrary is proved, it seems permissible to believe that it is a case of "dilution."

Apart from being of scientific interest this yellow race of rye may prove to be of practical value as a garden plant. Being quite hardy, its bright yellow color would give a striking effect in the flower garden during the winter months, and more especially in the early spring.

A PLANT WITH UNDERGROUND SPINES

PLANTS and animals both have developed spines as a means of protection against their enemies but it is rare indeed to find a plant with the spines below ground. The all too common sawbrier (*Smilax Bonanox L.*) of the southern states and northern Mexico is one of the few plants thus provided (Fig. **10**). The stems above ground are spiny to keep off grazing animals but the underground starchy tubers are armored densely with spines apparently developed as a protection against peccaries—the wild pigs still found in the southwest. The sawbrier is undoubtedly spreading rapidly northward from Mexico and is now beyond the original range of the wild pigs but its armor comes into use against the ravages of the domesticated hog of the old world.

It is an interesting thing that the greenbriers of this region are very well fitted to survive against most of the adverse conditions imposed by civilization. They are all geologically newcomers in America and all actively spreading—some from the south and some from the east. *Smilax hispida* came in from the northwest ages ago and has now reached the Atlantic coast where it is found in association with *S. rotundifolia* whose relatives are all European. The invasion of the greenbriers will probably go on until they will all spread over the whole region.

The sawbrier (*Smilax Bonanox*) is better fitted to survive than any of its relatives who, while they have spines above ground, rarely have any below although they show enough traces of a spiny cover to suggest the way in which this interesting armor was evolved.

What Determines Longevity?

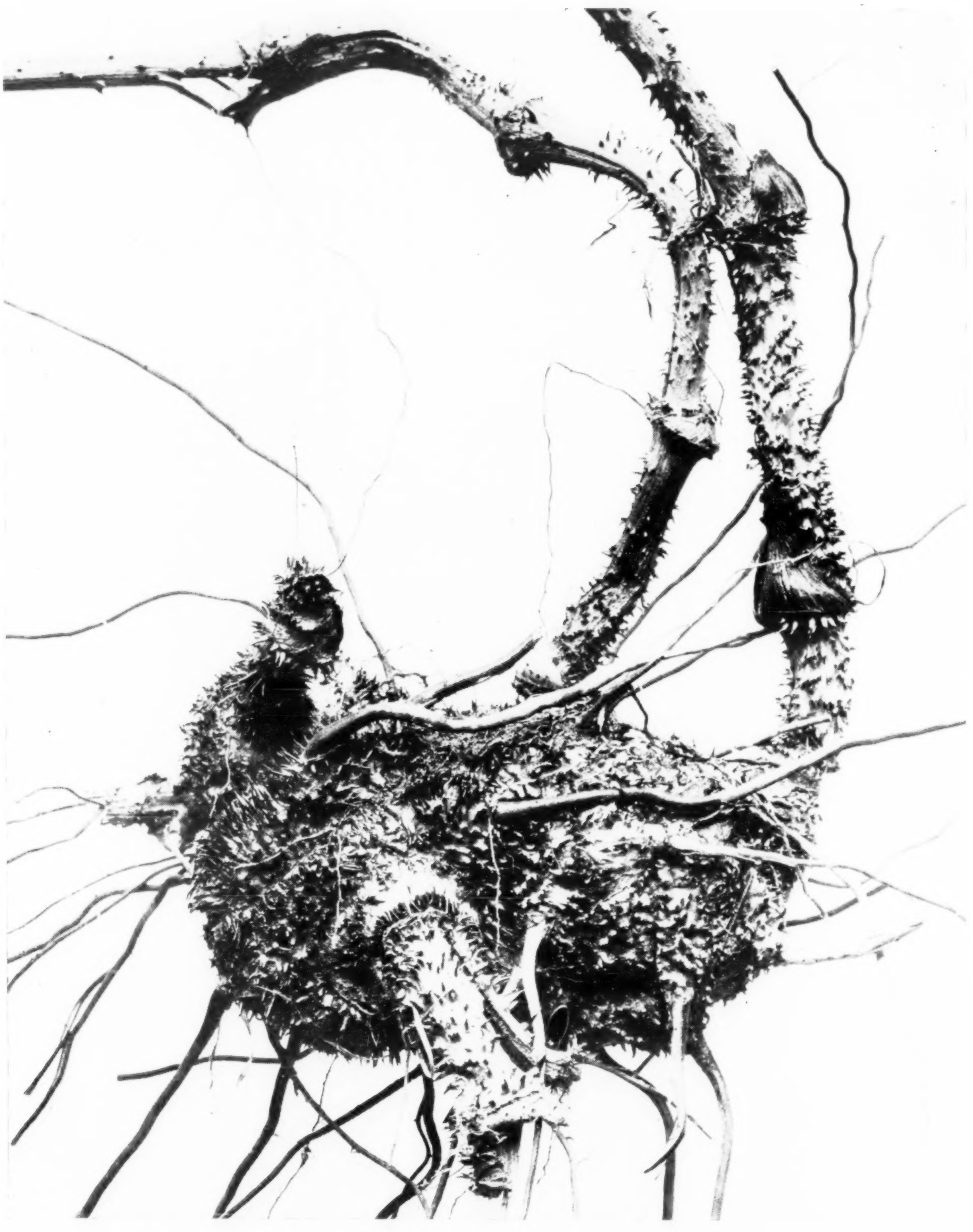
Under normal conditions, most complex animals have a characteristic and rather sharply defined duration of life. But one celled animals, which reproduce by fission, are apparently immortal unless life is stopped by what may be called an accident, for as the cell divides in half, neither part may be called the parent, and both halves will go on reproducing. And by taking cuttings from a plant, a part of the original may be kept living indefinitely by repeated cuttings, while the parent plant dies at the close of its usual duration of life. Thus it would appear that natural death is connected only with organisms which are composed of different organs which are inseparable.

Jacques Loeb and J. H. Northrop began experiments in 1908[1] in an attempt to find some of the causes which regulate the duration of life. Their work was carried on with the fruit-fly, Drosophila, which has a characteristic duration for both the larval and adult stages. It has already been definitely proved that the termination of the first stage of a metamorphosis is determined by the production in the body of certain chemical constituents not heretofore present.

It is known that various life processes have the same "temperature coefficient" as chemical reactions—every increase of 10° C. in the temperature doubles the speed of the process (or the reaction). This is, naturally, if such life-processes are themselves due to chemical reactions.

By breeding fruit flies at different temperatures, Loeb and Northrop seemed to find a similar temperature coefficient. Every increase of **10** degrees meant that the flies bred at that temperature reached the end of their lives just twice as rapidly as those bred in a temperature **10** degrees cooler. Hence, the authors think, it may be that longevity itself is determined by a chemical reaction—that normal death from old age is due to the production in the system of some poison which did not previously exist there.

[1] Loeb, Jacques, and J. H. Northrop. What Determines the Duration of Life in Metazoa? *Proc. Nat. Acad. Sci.*, iii, pp. 382–386. May, 1917.



UNDERGROUND SPINES FURNISHED DEFENSE AGAINST PECCARIES

The sawbrier (*Smilax Bonanox*) is one of the few plants which are furnished with underground spines. Its relatives all have spines above ground, but the sawbrier was forced to develop spines below ground as well in order to protect itself against the efforts of wild pigs to get at its starchy roots. Although the wild pigs are not now so numerous in many localities as to be a menace to the plant, the sawbrier still finds the spiny armor a valued protection against the domesticated hog. The above photograph is from a specimen collected in South Carolina by J. B. Norton, who is at present working on the relationship and past history of this group and the manner in which the different species reached America from the original home of the genus in northern India. (Fig. 10.)

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